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The Impact of Hospital Financing on the Quality of Inpatient Care in England

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Abstract

We assess the impact of the English version of prospective payment, termed Payment by Results (PbR), on hospital quality, as measured by in-hospital mortality and 28-day emergency readmission. To do this, we exploit the phased introduction of PbR across hospitals and across three treatments (hip replacement, hernia repair and stroke) which were exposed to PbR at different times. We estimate regression models to analyse factors associated with patient survival and readmission for all those admitted for hip replacement (n=499,555), hernia repair (n=414,959) or following stroke (n=487,040) between 2002/3 and 2007/8. Factors include patient and hospital characteristics and the proportion of hospital income derived from PbR. We find that the probability of survival improved over time while changes in crude readmission rates varied by condition. Patient characteristics are important at explaining survival and readmission, and hospital size and specialisation also appear significant, though not consistently so across conditions or time. The probability of surviving stroke is lower for those admitted over the weekend. Given the high mortality rate for stroke, it is critical to account for the probability of surviving the initial admission when evaluating readmissions. PbR does not appear to have influenced the probability of survival or readmission.

Key words: hospital financing, quality, inpatient care, mortality, readmission

1. Introduction

In April 2003 the Department of Health introduced a fundamental change to the payment system for hospital care in England (Department of Health, 2002). Previously, most hospital income came via block contracts negotiated locally between health care commissioners (largely primary care trusts) and health care providers (largely hospital trusts). Each block contract would involve a commissioner buying a specific volume of activity from a provider for an agreed cost over a fixed time period (usually one year). Such contracts allowed hospitals to use their own cost circumstances to negotiate higher payment. There was little incentive for hospitals to increase activity above the level specified in the contract because commissioners might have little funding left to pay for such additional activity and, sometimes, commissioners imposed explicit limits on activity levels.

The new system, called 'Payment by Results' (PbR), was first introduced in April 2003 and was phased in over several years. It established a more direct link between a hospital's revenue and the number and complexity of patients treated, with hospitals receiving a fixed payment – the national tariff – for each type of patient treated. Under PbR, the price for hospital care is defined in terms of the healthcare resource group (HRG) for the spell of care in hospital, with different conditions (eg stroke or hip replacement) assigned to different HRGs. Initially, only fifteen HRGs were subject to PbR but in April 2004 the coverage of the scheme was extended in two ways (Street and Miraldo, 2007). First, a further 33 HRGs were added to the PbR scheme and, second, the first ten Foundation Trusts (FTs) were announced. Hospital Trusts with a good record for clinical quality and financial management were able to apply for Foundation status from April 2004. One advantage associated with Foundation status was that these hospitals enjoyed a far greater degree of autonomy than non-Foundation Trusts and these high performing hospital trusts were able to price most of their activity according to the national tariff rather than having to negotiate prices with local commissioners. FTs continued to negotiate on total cost and target volume, estimating the mix of activity costed at tariff rates. Activity levels that varied from expectations were also paid for at tariff rates.

The Department of Health (2002) identified three main reasons for introducing a standard national tariff: to enable commissioners to focus on the quality and volume of services provided; to provide incentives for hospitals to manage costs efficiently; and to increase the ability of commissioners and providers to plan capacity for the future, agreeing target volumes rather than arguing over prices. As Farrar et al (2009) have noted, these objectives imply linkages between the implementation of PbR, the behaviour of commissioners and providers, and the performance of the NHS hospital sector in England.

The imposition of a national tariff increases the incentives for hospitals to lower costs and assess their levels of activity. For hospitals with marginal costs below the tariff, the surplus earned can be retained. Such "profit-making" hospitals have a financial incentive to increase activity. For hospitals with marginal costs above the tariff there is pressure to reduce costs and/or activity - or else risk falling into financial deficit. Of course, these expectations might not be realised in practice, particularly if hospitals have poor information about their marginal costs (Mannion, Marini and Street 2008).

There is also a risk that hospitals might respond to PbR by reducing the quality of care, in the belief that this may generate savings. These savings might be realised by skimping on quality during the hospital stay or by discharging patients too soon. In this paper, we examine whether the replacement of block contracts with PbR has been associated with a change in hospital quality. We use in-hospital mortality and emergency re-admission within 28 days after discharge as indicators of hospital quality. Rather than study all patients admitted to hospital, we focus on people admitted for: (a) stroke care; (b) hernia repair; and (c) hip replacement. We have selected these three groups

because (i) they have very different baseline mortality and re-admission rates and (ii) the phasing of PbR meant that the switch from block contracts happened at different times for these conditions.

The plan of the paper is as follows. Section 2 provides a brief summary of why hospital quality might vary according to financial arrangements and of the literature on the subject. Section 3 provides details of our study methods. It outlines the statistical methods used to test the hypothesis as well as the data sources that have been drawn upon to facilitate this testing. Section 4 presents details of the study dataset and section 5 contains our empirical results. Section 6 discusses our results and section 7 offers some concluding remarks.

2. Previous studies

England was a late adopter of a Prospective Payment System, of which PbR is an example. PPS was first introduced in the United States in 1983, where it replaced retrospective, cost-based reimbursement. Evaluation of the impact of this change in hospital financing on quality found mixed results. On the one hand, it was argued that the tighter financial regime of PPS would encourage hospitals to shift costs onto others, an early discharge tactic labelled "quicker and sicker" and, indeed, researchers found some evidence of this (Kosecoff et al., 1990). On the other hand, there was also evidence of improvements in in-hospital processes of care and no changes in post-discharge mortality (Kahn et al., 1990; Rogers et al., 1990).

Unlike the US, in most other countries PPS replaced hospital payment systems more akin to the global budget or block contract arrangements that used to pertain in England (Busse et al, 2013). In this situation, it is not possible to predict the quality response to the change to a PPS-type financial system. The response depends on the relationship between the hospital's marginal cost (MC) and their marginal revenue (MR), here the prospectively determined national tariff.

Under PPS, hospitals with MC<MR have an incentive to increase activity because it is profitable to do so. This incentive would not have obtained under a global budget or block contract, with additional payments not being guaranteed if volumes exceeded those stipulated in the contract. PPS relaxes these volume controls. In order to attract more patients, hospitals might improve quality. This was an expressed expectation of those who designed PbR arrangements in England (Department of Health, 2002).

But some hospitals might have reacted differently to the replacement of block contracts with PPS. Hospitals faced with MC>MR risk running deficits. One way to address this is by scaling back activity. However, this may exacerbate the financial problem if MR falls faster than MC, a likely scenario whenever a high proportion of costs are fixed or semi-fixed. An alternative is to maintain activity levels but to reduce average costs per person. This might be achieved by reducing quality.

Farrar et al. (2007) and (2010) present two studies of PbR with the latter (using the study period 2002/3 to 2007/8) being an updated and extended version of the former. Both studies look at the impact of PbR on a variety of indicators including the length of stay, the volume of activity, in-hospital mortality, 30-day mortality following coronary artery bypass graft, and 28-day emergency readmission following admission for hip fracture. Farrar et al conclude that the introduction of PbR does not appear to have affected the quality of care. In fact, the two studies find a small decrease in both in-hospital mortality and 30-day surgical mortality, and no change in the 28-day emergency readmission rate for hip fracture.

To try to isolate the impact of PbR from contemporaneous events, Farrar et al compared English hospitals to those in Scotland which were assumed to be similar to their English counterparts with the exception that they were not exposed to a change in financial arrangements. Hence, Scottish hospitals were used as controls in a difference-in-difference analysis. The drawback of this approach is the assumption that Scottish and English hospitals were similar in all contemporaneous respects other than their exposure to PbR. However, PbR was not the only policy being implemented in England over the period with other initiatives, such as the imposition of strict waiting times targets, also differentiating hospitals in the two jurisdictions.

The present study complements those by Farrar et al but, instead of using Scottish hospitals as controls, we exploit the phased introduction of PbR within and across English hospitals as a means to isolate its impact. As we shall detail in the next section, this phasing took two forms. First, PbR was

applied at national level to some procedures ahead of others. Second, in progressively more hospitals, all activity was subject to PbR ahead of the procedure-level phasing of PbR. Unfortunately, we do not observe each hospital's marginal costs, and even hospitals may have mistaken beliefs about their costs (Mannion et al, 2008), so it is not possible to determine the behavioural response according to each hospital's cost structure. However, we are able to assess the average impact nationally of PbR on quality by using both procedures and hospitals as counterfactuals.

3. Methods and modelling approach

For patients admitted for hip replacement, hernia repair and stroke care, we have two dependent variables: in-hospital survival and 28-day readmission. Our empirical strategy is designed to identify the impact of PbR on each of these outcomes. We do this in two ways. First, we exploit the differential phasing over time of PbR for each condition, taking the year (2002/3) prior to the introduction of PbR as our starting point. Hip replacement was designated among the first tranche of conditions subject to PbR in 2003/4, hernia repair followed in 2004/5, while payments for stroke care became subject to PbR as the policy was phased-in generally. Second, we exploit the differential phasing across hospitals, noting that as hospitals became Foundation Trusts all of their activity was paid under PbR. This allows us to create a variable for each inpatient episode indicating how much of the income of the hospital in which they were treated was subject to PbR at the time of their treatment. This proportion will vary over time and across hospitals. The following episodes were wholly subject to PbR:

(i) all episodes undertaken by Foundation Trusts;
(ii) all elective episodes covered by the 15 HRGs subject to PbR from 2003/4; and
(iii) all elective episodes covered by the 33 additional HRGs subject to PbR from 2004/5.

All episodes not covered by i, ii, and iii above will have been subject to a phased application of PbR from 2005/6. The value for the PbR-based variable assigned to these episodes (0.25 for 2005/6, 0.50 for 2006/7, and 0.75 for 2007/8) reflects the proportion of the 'price' of the episode that was subject to PbR for these years (Audit Commission, 2008). For each hospital and for each year, the proportion of total inpatient hospital activity subject to PbR is then simply the sum of the values taken by this PbR-based variable across all patient episodes divided by the total number of patient episodes.

As well as indicating the strength of PbR, our modelling approach recognises that the mortality and readmission outcomes will vary across patients because (i) patients have different characteristics with regard to demographics, co-morbidities, diagnoses and treatment; and (ii) patients are treated in different hospitals. Hence empirical studies typically use regression analysis to model outcomes of interest as a function of various patient- and hospital-level characteristics. We describe the variables used to capture these characteristics below.

The probability of in-hospital survival is estimated as a probit model. Modelling the probability of readmission, however, requires further considerations. Recently Laudicella et al (2013) have argued that the likelihood of readmission will in part reflect the survival rate associated with the initial admission. They point out that, if patient characteristics are not perfectly observable and hospitals differ in the quality of care they provide (and their mortality rates), then hospitals with low mortality rates are likely to have a larger share of un-observably sicker patients at risk of a readmission. In other words, even if patients can be assumed to be randomly assigned to hospitals at the point of their first admission, this assumption is likely to be violated after the survival selection process.

To address this sample selection problem, Laudicella et al (2013) propose relaxing the assumption of independence between patient survival and readmission implicitly adopted in most previous empirical studies of readmission (see, for example, Vest et al, 2010; Westert et al, 2002; Yam et al, 2010). They suggest the use of Heckman's bivariate sample selection model which allows for the correlation between survival and readmission. This involves the estimation of both a survival model and a readmission model with the probability of readmission conditioned on survival.

It is not unreasonable to assume that the same patient- and hospital-level variables that influence the probability of readmission will also affect the probability of survival. But to be able to disentangle what drives each type of probability, it is necessary to identify variables that explain the probability of survival (the selection equation) but which are uncorrelated with the probability of readmission (the outcome equation).

Laudicella et al argue that the date/day of the week satisfies this condition. Mortality risk is greater during weekends and over long bank holiday periods (such as at Easter and Christmas) because experienced nursing and medical staff are less available (Dr Foster Intelligence, 2011; Hauck and Zhao, 2011). But Laudicella et al argue that the day of the original admission has no bearing on the probability of readmission, this being dependent '…on post-operative care that can be provided more flexibly over a long period of time once survival has been assured.' We adopt this identification strategy by including indicators of the date/day of the week on which the patient is admitted in the survival model but not in the readmission model. For further details about the estimation of sample selection models see Cameron and Trivedi (2009).

In summary, the bivariate sample selection model to be estimated comprises two equations. We first model the probability of patient *i* in hospital *h* at time *t* surviving the first admission, as a function of the latent propensity of surviving S^*_{iht}

$$S^*_{iht} = \propto + \beta_1 X_{iht} + \beta_2 D_{iht} + \gamma Z_{ht} + \delta P_{ht} + T_t + \varepsilon_{1iht}$$

$$S_{iht} = \begin{cases} 1 \; if \; S^*_{iht} > 0 \\ 0 \; if \; S^*_{iht} \leq 0 \end{cases}$$

where X_{ih} is a vector of socio-economic, diagnosis and treatment variables measured for each patient; D_{ih} is a vector of dummy variables reflecting the day of admission or whether it occurred during Christmas or Easter holidays; $Z_h$is a vector of characteristics describing the hospital; P_h captures the proportion of the hospital's funding that was subject to PbR; T_t is a vector of year dummies (baseline 2002/3); and ε_{1iht} is random error assumed to take a bivariate standard normal distribution and to be uncorrelated with the explanatory variables.

Following Laudicella et al, we allow for correlation between ε_{1iht} and the equivalent error term ε_{2iht} from the readmission equation, and model readmission conditional upon the patient having survived the original admission, similarly assuming a latent propensity of readmission R^*_{iht} :

$$R^*_{iht} = \propto + \beta_1 X_{iht} + \gamma Z_{ht} + \delta P_{ht} + T_t + u_{ht} + \varepsilon_{2iht}$$

$$R_{iht} = \begin{cases} 1 \; if \; R^*_{iht} > 0 \\ 0 \; if \; R^*_{iht} \leq 0 \end{cases}$$

These models are estimated separately for each of the three conditions. As well as pooled temporal analyses, we also estimate the models separately for each of the six years, and these annual results are presented in an appendix.

4. Data and sources

4.1 Patient-level variables

The estimation of the survival and readmission models requires the identification of: (i) those patients that are admitted for each of the selected conditions; (ii) those patients that die during their initial spell in hospital; and (iii) those patients that are subsequently re-admitted as emergencies within 28 days of their initial discharge from hospital.

The Hospital Episodes Statistics (HES) database contains details of NHS funded patients admitted to public and private hospitals and treatment centres in England. The database includes both patients staying overnight as well as day case patients. On admission to hospital each patient is assigned to the care of a specific consultant and the records within the database are known as 'consultant episodes'. When a patient leaves the care of a particular consultant (eg because they are discharged from hospital), their consultant episode becomes a 'finished consultant episode' (FCE). If the patient remains in hospital but is transferred to another consultant, the initial consultant episode is closed and a new consultant episode is opened. A multi-episode period of care within the same hospital is known as a spell of care, and it is the spell that is assigned to an HRG and which can be used to identify the national tariff for the patient's hospital care. Each FEC contains information about the patient (eg their age and gender), details of their diagnosis, and information about any operative procedures undertaken on them.

A patient is defined as having a stroke if the primary diagnosis is either ICD-10 I61 (intracerebral haemorrhage), ICD-10 I63 (cerebral infarction) or ICD-10 I64 (unspecified stroke). A spell is defined as a stroke spell if any of the spell's constituent episodes is a stroke episode. A patient is defined as having a hip replacement if the OPCS4 primary operative procedure associated with the episode is either W37, W38, W39, W46, W47, W48, W93, W94 or W95. A spell is defined as a hip replacement spell if any of its constituent episodes is a hip replacement episode. An episode is defined as an inguinal hernia episode if the primary diagnosis is ICD-10 K40 and the primary operative procedure is either T20 or T21. A spell is defined as an inguinal hernia spell if any of its constituent episodes is an inguinal hernia episode.

For each of the three study conditions, we identify all patients admitted over six 12-month periods (that is, for the six fiscal years from 2002/3 to 2007/8 inclusive). All outpatient attendances and inpatients aged less than one year are excluded from this study. We use 2002/3 as the first study period because this is the year prior to the first application of PbR. We use 2007/08 as the most recent study period because, from 2008/09, virtually all activity was subject to PbR. Thus it is during this six-year period that there will have been variation across hospitals in the amount of their activity that was subject to PbR.

Information from HES was used to construct the two dependent variables in the sample selection model:

(a) for the survival model: the dependent variable either takes the value of zero if the patient died during the initial hospital spell or it takes a value of one if the patient survived the initial spell (there is a variable in HES that can be used to identify whether a patient died during the spell); and

(b) for the readmission model: the dependent variable either takes the value of zero if the spell is not associated with an emergency readmission within 28 days, or it takes a value of one if the initial spell is associated with an emergency readmission within 28 days.

For each of the study years, the HES database was used to sort each patient's episodes of care into chronological order, and spells of care for the same patient within the same hospital were identified. Our identification of emergency readmissions follows the methodology employed by the National Centre for Health Outcomes Development (NCHOD) in producing hospital standardised readmissions rates to monitor hospitals' performance (NCHOD, 2011). Consistent with national definitions, emergency readmissions associated with either cancer, chemotherapy, learning disability, maternity, or psychiatry were not counted as readmissions for the purposes of this study (NCHOD, 2011).

The variables describing patient characteristics were also constructed from information contained in HES. Five age categories reflecting the quintile distribution for each condition were constructed with the second category employed as the baseline category in the regression models. A dummy variable captures the patient's gender (1=male).

We included five Index of Multiple Deprivation (IMD 2004) dummies in the model to control for income deprivation associated with the area in which the patient resides. The IMD has seven domains, one of which is the Income Deprivation Domain. The purpose of this Domain is to measure the proportion of the population living in households experiencing income deprivation in all 32,482 small geographical areas of England (Office of the Deputy Prime Minister, 2004). These 32,482 small areas were divided into five quintiles according to the proportion of the population experiencing income deprivation, with the first quintile containing the most income deprived areas (the reference group) and the fifth quintile containing the least income deprived areas. Patients were assigned to a quintile group according to the area in which they lived immediately before admission to hospital. Patients that could not be assigned to one of the five quintiles (eg because their address was incorrectly or incompletely recorded in HES) were attributed to a residual IMD category.

We included a dummy variable to reflect whether the patient had been admitted through the emergency department, and two other dummies for whether the patient had been transferred from or to another institution as part of their care pathway. A patient with co-morbidities is less likely to survive the initial admission than one without such comorbidities. We take account of the comorbidities used in the construction of the Charlson index (Charlson et al., 1987; Quan et al., 2005). Rather than using the index itself, we define three distinct patient groups based on their Charlson comorbidities. The first involves specifying five of the 17 Charlson comorbidities as 'severe', these being renal disease, cancer, moderate or severe liver disease, metastatic solid tumour and AIDS/HIV (Charlson et al., 1987). The comorbidities of cerebrovascular disease and hemiplegia/paraplegia were ignored for the stroke analyses as these diagnoses are directly related to the condition being studied (in which case they are not comorbidities). The other comorbidities are designated 'non-severe'. We then define a dummy variable indicating whether the patient suffered from a single non-severe comorbidity and another dummy variable indicating at least one severe or two non-severe comorbidities. All other patients suffered from no comorbidity (and form the reference group).

For stroke patients, we also tested the impact of a secondary diagnosis for pneumonia (ICD-10 J13-J18, J69) via the addition of a dummy variable to the model (Christensen et al, 2009). Some spells, with multiple episodes, record two different stroke subtypes in the primary diagnosis field for the episodes within the spell. We identified the main diagnosis subtype by prioritising ICD-10 I61 (intracerebral haemorrhage) over both ICD-10 I63 (cerebral infarction) and ICD-10 I64 (unspecified stroke), and prioritising I63 (cerebral infarction) over I64 (unspecified stroke). We then constructed three dummy variables to reflect the main stroke diagnosis subtype for each spell. The dummy for I63 (cerebral infarction) was used as the reference stroke subtype. A further dummy was added for the presence of a secondary diagnosis of hemiplegia or paraplegia (ICD-10 G041, G114, G801, G802, G81, G82, G830, G831, G832, G833, G834, G839). The number of different diagnoses made and the

number of different procedures performed across the initial admission spell were also added as covariates to the model.

For patients having a hip replacement, we use dummy variables to account for whether they suffered a hip fracture, had a partial hip replacement or underwent a revision procedure. For those having hernia repair, we indicate whether or not it was a bilateral repair, or a laparoscopic repair, and whether or not the patient had a mesh implant to encourage skin growth; we also assess whether such patients had a diagnosis of hypertension or connective tissue disorder.

Finally, dummies for the day of the week on which the patient was initially admitted to hospital were added to the survival model (the baseline is admission on a Saturday) together with dummies for admission at Easter (on Good Friday or Easter Monday) and admission at Christmas (on Christmas Day or Boxing Day).

4.2 Hospital-level variables

We include six hospital level variables that might influence the probability of patient survival and/or re-admission. Larger hospitals might have more specialised equipment and/or staff and so, as a proxy for the size of the hospital, we included the hospital's number of acute beds. Survival and readmission might be affected if a hospital faces capacity constraints and we proxy this by percentage of acute beds that were occupied throughout the year. Dummies were used to reflect whether the hospital was (i) a teaching hospital, (ii) a specialist hospital, and (iii) a hospital located in the London area. We expected all three dummies to have a positive effect on the probability of patient survival and of not being readmitted within 28 days.

5. Results

5.1 Descriptive statistics

Figure 1 presents annual mortality and 28-day readmission rates for all three study conditions. In-hospital mortality fell from 27.6% in 2002/3 to 22.8% in 2007/8 for stroke patients, while the 28-day readmission rate increased from 8.3% to 9.8%. For hip replacement patients, mortality fell from 4.0% to 3.3% and the readmission rate increased very slightly from 7.8% to 8.0%. In-hospital mortality for hernia repair patients remained at a very low level throughout the period, falling from 0.19% to 0.16%, while the 28-day readmission rate increased slightly from 1.7% to 2.0%.

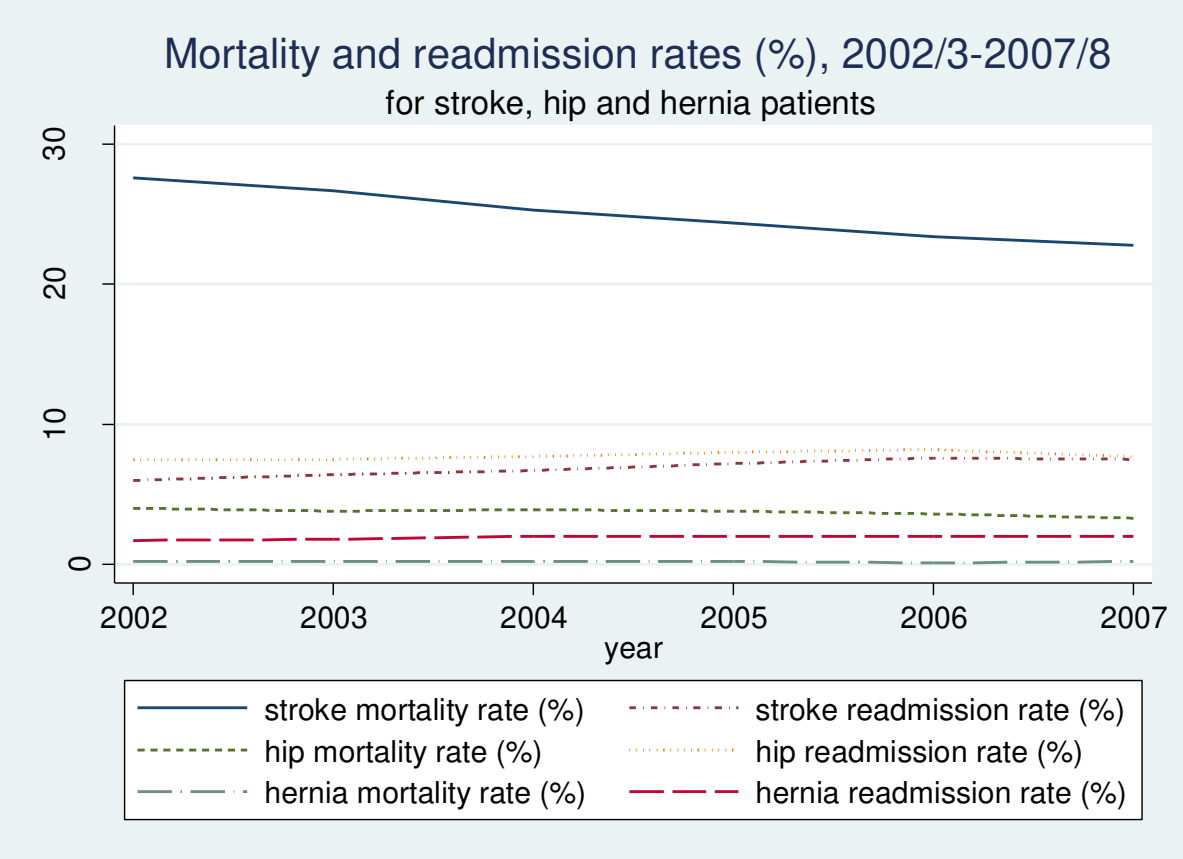

Figure 1 Mortality and 28-day readmission rates for stroke, hip and hernia patients, 2002/03-2007/08

Stroke descriptives

Descriptive statistics for the patient level variables employed in the stroke sample selection model for the pooled six-year period 2002/03-2007/08 can be found in table 1a (similar descriptive statistics for each individual year can be found in tables A19-A24 in the appendix). Over the six year period, 487,040 people were admitted to hospital after suffering a stroke, the annual number falling slightly from 83,018 in 2002/3 to 79,601 in 2007/8. The average age at admission was 75 years. The age profile was stable over time and 47% of patients were male.

Of the 487,040 stroke patients, 9% had pneumonia, 13% suffered intracerebral haemorrhage, 55% had a cerebral infarction and for 32% the type of stroke was unspecified (ICD10 I64). The majority (94%) were admitted as emergencies, with 28% being transferred between hospitals. 12% of admissions occurred on a Saturday and another 12% occurred on a Sunday, with around 15% admitted on every other day of the week. On average, 4.9 separate diagnoses were recorded per patient, and few procedures were performed, only 0.7 per patient.

Table 1 Descriptive statistics for the variables employed in the regression models, pooled, 2002/03-2007/08

(a) stroke patients

Variable	Obs	Mean	Std. Dev.
Survived	487,040	0.749	0.433
Re-admitted	364,949	0.092	0.289
Age 1-60 years	486,666	0.14	0.347
Age 61-70 years	486,666	0.161	0.368
Age 71-80 years	486,666	0.307	0.461
Age 81-85 years	486,666	0.189	0.392
Age over 86 years	486,666	0.203	0.402
Age	486,666	74.8	13.43
Male	487,040	0.471	0.499
Charlson index=0	487,040	0.609	0.488
Charlson index=1	487,040	0.255	0.436
Charlson index=2	487,040	0.136	0.343
Pneumonia	487,040	0.09	0.287
Intracerebral haemorrhage	487,035	0.133	0.339
Cerebral infarction	487,035	0.546	0.498
Unspecified stroke	487,035	0.321	0.467
Emergency	487,035	0.944	0.23
Patient dies	487,035	0.251	0.433
Transfer in	481,478	0.078	0.268
Transfer out	481,478	0.198	0.398
Hemi/paraplegia	487,035	0.081	0.273
No. of diagnoses	487,032	4.93	3.059
No. of procedures	487,032	0.737	1.371
IMD Quintile 1 (most deprived)	487,040	0.206	0.404
IMD Quintile 2	487,040	0.245	0.43
IMD Quintile 3	487,040	0.209	0.407
IMD Quintile 4	487,040	0.182	0.386
IMD Quintile 5 (least deprived)	487,040	0.144	0.351
IMD Quintile Unknown	487,040	0.014	0.117

(b) hip replacement patients

Variable	Obs	Mean	Std. Dev.
Survival dummy	499,555	0.963	0.189
Readmission dummy	480,953	0.081	0.272
Age 1-63 years	499,314	0.195	0.397
Age 64-71 years	407,648	0.215	0.411
Age 72-77 years	499,314	0.2	0.4
Age 78 -83 years	499,314	0.195	0.396
Age over 84 years	499,314	0.195	0.397
Age	499,318	73.11	12.01
Male	499,555	0.334	0.472
Charlson index=0	499,555	0.721	0.448
Charlson index=1	499,555	0.196	0.397
Charlson index=2	499,555	0.083	0.276
Hip fracture dummy	499,555	0.298	0.458
Partial hip replacement	499,555	0.292	0.455
Revision dummy	499,555	0.121	0.327
Emergency	499,555	0.373	0.484
Patient dies	499,555	0.037	0.189
Transfer in	497,332	0.028	0.165
Transfer out	497,332	0.122	0.327
No. of diagnoses	499,555	3.673	2.678
No. of procedures	499,555	2.541	1.13
IMD Quintile 1 (most deprived)	499,555	0.142	0.349
IMD Quintile 2	499,555	0.224	0.417
IMD Quintile 3	499,555	0.226	0.418
IMD Quintile 4	499,555	0.216	0.411
IMD Quintile 5 (least deprived)	499,555	0.179	0.384
IMD Unknown	499,555	0.014	0.116

(c) hernia repair patients

Variable	Obs	Mean	Std. Dev.
Survived	414,959	0.998	0.041
Re-admitted	414,275	0.019	0.137
Age 1-42 years	414,899	0.205	0.404
Age 43-56 years	414,899	0.203	0.403
Age 57-65 years	414,899	0.2	0.4
Age 66-74 years	414,899	0.197	0.398
Age over 75 years	414,899	0.194	0.395
Age	414,899	57.98	18.14
Male	414,959	0.928	0.259
Charlson index=0	414,959	0.889	0.314
Charlson index=1	414,959	0.088	0.284
Charlson index=2	414,959	0.022	0.148
Inguinal hernia: bilateral diagnosis	414,959	0.075	0.263
Inguinal hernia: other diagnosis	414,959	0.033	0.178
Comorbid: hypertension dummy	414,959	0.124	0.33
Comorbid: connective tissue disorder	414,959	0.022	0.148
Laparoscopic repair	414,959	0.105	0.306
Presence of implant	414,959	0.829	0.377
Emergency	414,959	0.051	0.22
Patient dies	414,959	0.002	0.041
Transfer in	414,511	0.003	0.054
Transfer out	414,511	0.004	0.063
No. of diagnoses	414,959	1.767	1.337
No. of procedures	414,959	2.25	0.648
IMD Quintile 1 (most deprived)	414,959	0.162	0.368
IMD Quintile 2	414,959	0.222	0.416
IMD Quintile 3	414,959	0.215	0.411
IMD Quintile 4	414,959	0.21	0.407
IMD Quintile 5 (least deprived)	414,959	0.185	0.388
IMD Unknown	414,959	0.005	0.074

Table 1 Descriptive statistics for the variables employed in the regression models, pooled, 2002/03-2007/08 continued

(a) stroke patients				(b) hip replacement patients				(c) hernia repair patients			
Variable	Obs	Mean	Std. Dev.	Variable	Obs	Mean	Std. Dev.	Variable	Obs	Mean	Std. Dev.
Sunday admission	487,040	0.119	0.324	Sunday admission	499,555	0.121	0.327	Sunday admission	414,959	0.031	0.173
Monday admission	487,040	0.159	0.366	Monday admission	499,555	0.179	0.384	Monday admission	414,959	0.192	0.394
Tuesday admission	487,040	0.154	0.361	Tuesday admission	499,555	0.177	0.381	Tuesday admission	414,959	0.194	0.395
Wednesday admission	487,040	0.149	0.356	Wednesday admission	499,555	0.182	0.386	Wednesday admission	414,959	0.194	0.396
Thursday admission	487,040	0.149	0.356	Thursday admission	499,555	0.165	0.371	Thursday admission	414,959	0.2	0.4
Friday admission	487,040	0.148	0.355	Friday admission	499,555	0.111	0.314	Friday admission	414,959	0.163	0.37
Saturday admission	487,040	0.123	0.328	Saturday admission	499,555	0.064	0.245	Saturday admission	414,959	0.026	0.159
Christmas admission	487,040	0.005	0.068	Christmas admission	499,555	0.003	0.051	Christmas admission	414,959	0	0.015
Easter admission	487,040	0.005	0.071	Easter admission	499,555	0.003	0.058	Easter admission	414,959	0.001	0.032
No. of acute beds	486,136	766.674	396.751	No. of acute beds	498,818	719.071	388.599	No. of acute beds	414,225	743.434	378.636
Bed occupancy rate	486,136	0.852	0.057	Bed occupancy rate	498,818	0.844	0.062	Bed occupancy rate	414,225	0.852	0.057
Teaching hospital	487,035	0.171	0.377	Teaching hospital	499,555	0.129	0.335	Teaching hospital	414,959	0.154	0.361
Specialist hospital	487,035	0.002	0.044	Specialist hospital	499,555	0.039	0.194	Specialist hospital	414,959	0.001	0.037
London hospital	487,035	0.124	0.329	London hospital	499,555	0.104	0.305	London hospital	414,959	0.128	0.335
FCEs s.t. PbR rate	487,035	0.303	0.361	FCEs s.t. PbR rate	499,555	0.331	0.366	FCEs s.t. PbR rate	414,959	0.309	0.364
Year is 2002	487,040	0.17	0.376	Year is 2002	499,555	0.153	0.36	Year is 2002	414,959	0.167	0.373
Year is 2003	487,040	0.168	0.374	Year is 2003	499,555	0.162	0.369	Year is 2003	414,959	0.171	0.376
Year is 2004	487,040	0.167	0.373	Year is 2004	499,555	0.162	0.369	Year is 2004	414,959	0.166	0.372
Year is 2005	487,040	0.167	0.373	Year is 2005	499,555	0.166	0.372	Year is 2005	414,959	0.166	0.372
Year is 2006	487,040	0.163	0.369	Year is 2006	499,555	0.172	0.377	Year is 2006	414,959	0.162	0.369
Year is 2007	487,040	0.163	0.37	Year is 2007	499,555	0.184	0.387	Year is 2007	414,959	0.169	0.375

Hips descriptives

Descriptive statistics for the patient level variables employed in the hip sample selection model for the pooled six-year period 2002/03-2007/08 can be found in table 1b (similar descriptive statistics for each individual year can be found in tables A25-A30 in the appendix). 499,555 people had a hip replacement over the full period, the number rising from 76,505 in 2002/3 to 91,751 in 2007/8, a clear reflection of the priority afforded to people previously waiting for long periods before being treated (Department of Health, 2002).

The average age was 73 years, 33% of patients were male, 29% had a partial hip replacement and 12% were undergoing a revision procedure. 37% of patients were admitted as emergencies and 15% were transferred between hospitals. The average patient had 3.7 separate diagnoses recorded and underwent 2.5 procedures.

The way that hospitals schedule hip replacement activity is reflected in variations in the proportions admitted across the week. Patients are most likely to be admitted on Monday to Thursday (16-18%) and much less likely to be admitted on Friday (11%), Saturday (6%) or Sunday (12%).

Hernia descriptives

Table 1c shows that in total 414,959 people had a hernia repair during the six year period, the annual number remaining stable at around 70,000 a year (see tables A31-A36 for figures for individual years). Less than 0.2% of patients died in hospital while 2% were subsequently readmitted as emergencies.

The average age of a patient was 58 years, and the vast majority (93%) were male. Most (90%) had a unilateral diagnosis and 7.5% had a bilateral diagnosis. On average 10.5% had a laparoscopic repair, this proportion rising from 5.9% in 2002/3 to 16.3% in 2007/8. 83% of patients had a mesh implant to encourage skin growth, the proportions increasing from 80.7% to 84.4% over the full period. 12% were diagnosed with hypertension and 2% had a connective tissue disorder. 5% were admitted as emergencies and very few (<1%) were transferred between hospitals. Only 3% of patients were admitted on Saturday or Sunday, with around 19% admitted on Monday to Thursday, and 16% on Friday.

Hospital descriptives

The hospital descriptive statistics vary slightly by condition but in the interests of brevity we focus on those for stroke patients here (see table1a). The average number of acute beds per hospital was around 770. The average acute bed occupancy rate was just over 85% but this ranged from 62% to 100%. Just over 17% of patients were in a teaching hospital and 12% were in a London hospital. In 2003/04 just under 2% of hospital activity was subject to PbR and by 2007/8 the average percentage of hospital activity subject to PbR had increased to around 76%. This considerable growth across the study period reflects the phased introduction of both PbR and Foundation Trusts (in 2003/4 there were no Foundation Trusts).

5.2 Regression analysis

Stroke: survival

The pooled regression results for stroke patients can be found in table 2 (results for individual years can be found in tables A1-A6 in the appendix). The first two columns (labelled (1) and (2)) of table 2 report the average marginal effect and the standard error associated with variables present in the probit survival model.

Table 2 Survival and readmission results for stroke spells, 2002/03-2007/08 pooled

	(1) Sample selection model probit survival for stroke spells 2002/03-2007/08	(2) Sample selection model probit survival for stroke spells 2002/03-2007/08	(3) Sample selection model probit readmission for stroke spells 2002/03-2007/08	(4) Sample selection model probit readmission for stroke spells 2002/03-2007/08	(5) No sample selection probit readmission for stroke spells 2002/03-2007/08	(6) No sample selection probit readmission for stroke spells 2002/03-2007/08
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.052***	[0.003]	0.004	[0.003]	0.009***	[0.002]
Age 71-80 years	-0.075***	[0.002]	0.013***	[0.003]	0.001	[0.002]
Age 81-85 years	-0.153***	[0.003]	0.036***	[0.006]	0.008***	[0.002]
Age over 86 years	-0.245***	[0.004]	0.055***	[0.009]	0.009***	[0.003]
Male	0.032***	[0.001]	-0.007***	[0.002]	-0.001	[0.001]
Charlson index=1	-0.058***	[0.002]	0.024***	[0.003]	0.011***	[0.001]
Charlson index=2	-0.166***	[0.003]	0.034***	[0.007]	0.004**	[0.002]
Pneumonia	-0.434***	[0.005]	0.103***	[0.019]	0.009***	[0.003]
Intracerebral haemorrhage	-0.233***	[0.004]	0.091***	[0.011]	0.038***	[0.003]
Unspecified stroke	-0.102***	[0.005]	0.031***	[0.004]	0.010***	[0.002]
Emergency	-0.074***	[0.008]	0.050***	[0.009]	0.030***	[0.006]
Transfer in	-0.006	[0.006]	0.025***	[0.009]	0.019***	[0.007]
Transfer out			0.028***	[0.008]	0.022***	[0.007]
Hemi/paraplegia	0.022***	[0.005]	-0.012***	[0.004]	-0.007***	[0.003]
No. of diagnoses	0.011***	[0.001]	0.001	[0.001]	0.002***	[0.000]
No. of procedures	0.005***	[0.001]	-0.001	[0.001]	-0.000	[0.001]
IMD Quintile 2	0.002	[0.002]	-0.006**	[0.002]	-0.005**	[0.002]
IMD Quintile 3	0.005*	[0.003]	-0.015***	[0.003]	-0.011***	[0.002]
IMD Quintile 4	0.004	[0.003]	-0.018***	[0.003]	-0.014***	[0.002]
IMD Quintile 5 (least deprived)	0.011***	[0.003]	-0.024***	[0.003]	-0.017***	[0.003]
IMD Unknown	0.050***	[0.007]	-0.093***	[0.008]	-0.064***	[0.005]
Sunday admission	-0.000	[0.002]				
Monday admission	0.019***	[0.002]				
Tuesday admission	0.018***	[0.002]				
Wednesday admission	0.018***	[0.002]				
Thursday admission	0.013***	[0.002]				
Friday admission	0.015***	[0.002]				
Christmas admission	-0.033***	[0.009]				
Easter admission	-0.020**	[0.009]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000**	[0.000]	0.000**	[0.000]
Bed occupancy rate	-0.005	[0.046]	0.019	[0.043]	0.014	[0.035]
Teaching hospital	0.020***	[0.006]	-0.007	[0.007]	-0.003	[0.006]
Specialist hospital	0.065***	[0.021]	-0.009	[0.021]	0.001	[0.014]
London hospital	0.028***	[0.007]	0.011	[0.008]	0.012*	[0.007]
FCEs s.t. PbR rate	0.005	[0.008]	-0.008	[0.008]	-0.005	[0.006]
year2003	0.009***	[0.002]	0.004	[0.003]	0.004**	[0.002]
year2004	0.018***	[0.003]	0.007	[0.005]	0.008**	[0.004]
year2005	0.024***	[0.004]	0.011*	[0.006]	0.012**	[0.005]
year2006	0.029***	[0.005]	0.017**	[0.008]	0.018***	[0.006]
year2007	0.030***	[0.006]	0.014*	[0.007]	0.016***	[0.006]
Observations	480,265		480,265		359,694	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.434 (SE=0.058); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 42.97 Prob > chi2 = 0.0000; (iv) all standard errors are estimated with clustering by hospital.

In-hospital mortality following stroke improved year-on-year between 2002/3 and 2007/8 as indicated in Figure 1 and by the positive time trend on the year coefficients in table 2 for the model predicting survival following stroke.

There is a clear association between age and the probability of survival, with older people less likely to survive, as are women. There is also a higher probability of dying in hospital for patients admitted as emergencies (which is the majority at 94%), for patients with Charlson comorbidities, if the patient suffered from pneumonia or intracerebral haemorrhage or unspecified stroke (the reference group being those with a cerebral infarction), perhaps because the patient died before an accurate diagnosis was made. This would also tally with survival being positively related to the number of diagnoses recorded and procedures performed during the hospital stay. In this scenario, survival determines the number of diagnoses/procedures rather than vice versa.

There is no clear relationship between survival and socio-economic status, with the exception that those patients living in the most affluent quintile of small areas have a higher probability of survival. However, this difference is not present when the model is estimated across each year in isolation (see tables A1-A6 in the appendix).

As other studies have demonstrated (eg Hauck and Zhao, 2011), the probability of dying is significantly higher for stroke patients admitted over the weekend than for those admitted during the week. Survival is also significantly worse for those admitted over the Christmas and Easter holiday periods. The significance of the day of admission is not always apparent when looking at each single year, but holds in most years (again, see tables A1-A6 in the appendix).

Some hospital characteristics appear related to the probability of survival which is higher for patients treated in teaching, in specialist and in London hospitals, though the magnitude of these effects vary by year and are not significant every year (see tables A1-A6 in the appendix). The proportion of activity subject to PbR does not affect the probability of survival when the model is estimated across the six-year period as a whole. However, this variable is significant and has a negative effect on survival in one of the six years (2007/08) when the model is estimated on a year-by-year basis.

Stroke: readmission

Having conditioned on the probability of surviving the original hospital stay, column 3 of table 2 reports the average marginal effect of those factors associated with the probability of being readmitted within 28 days of discharge. The probability of readmission increases with age and is slightly higher for women than men. There is a clear socio-economic gradient, with the probability of being readmitted decreasing as income deprivation falls. The probability of readmission for those patients living in the least deprived quintile is 0.024 lower than for someone living in the most deprived quintile (ceteris paribus).

The probability of readmission is also higher for people with more Charlson co-morbidities, for those with a diagnosis of pneumonia or intracerebral haemorrhage or unspecified stroke, and for those originally admitted as emergencies or who were subject to a hospital transfer. The number of diagnoses or procedures recorded during the original admission tend not to be significant predictors of readmission, although the number of procedures is significant in some years (in 2002/3, 2003/4, and 2007/8).

The probability of readmission does not appear related to the hospital characteristics that we consider with the exception that those originally admitted to larger hospitals have a higher probability of readmission, though this variable is not always significant when each year of data is analysed separately (see tables A1-A6 in the appendix). The average marginal effect of the hospital

size variable is 0.0000164 so the probability of readmission increases by this amount for each extra acute bed. This is therefore a very small effect.

Figure 1 (and the model without sample selection) suggests an increasing trend in readmissions over time. But this is (in part) driven by improvements in survival. When these are taken into account, the increase in the probability of being readmitted in 2007/08 compared to 2002/3 is significant only at $p<0.1$ rather than at $p<0.01$.

Hips: survival

The pooled regression results for hip replacement patients can be found in table 3 (results for individual years are in tables A7-A12 in the appendix). The first two columns (labelled (1) and (2)) of table 3 report the average marginal effect and the standard error associated with variables present in the probit survival model.

Survival following hip replacement has improved over time, with in-hospital mortality falling from 4.0% in 2002/3 to 3.3% in 2007/8, as shown in figure 1.

Patient characteristics are associated with the probability of survival, which is lower for older patients and for men. There is also a socio-economic gradient with those from more affluent neighbourhoods having a greater probability of surviving than those from the lowest IMD quintile (although the differences do not always appear significant for every year of data).

There is a lower probability of survival for those admitted as emergencies and those transferred from another hospital. Survival probabilities are also lower for those with Charlson co-morbidities, more diagnoses, and more procedures, and for those who had a partial hip replacement.

Survival is unrelated to the day of admission but appears to be lower in hospitals with a greater bed occupancy rate and is higher in specialist hospitals. The latter result only holds for 2004/5 and 2005/6 when the data are analysed by year (see tables A7-A12 in the appendix for regression results by year). There is no relationship between survival and the proportion of hospital income derived from PbR.

Hips: readmission

Older patients and men face a higher probability of being readmitted within 28 days of discharge. There is also a socio-economic gradient, with those from the most income deprived communities facing a higher probability of readmission. The probability of readmission is also higher for those originally admitted as an emergency, for those with a non-severe Charlson co-morbidity and with more recorded diagnoses. The probability is lower for those who suffered a hip fracture but higher for those who had a revision. No hospital characteristics are related to the probability of readmission.

Readmission rates exhibit no significant temporal trends for those having a hip replacement, irrespective of whether we account for survival (compare the average marginal effects associated with the year dummies in columns (3) and (5)).

Hernia repair: survival

The pooled regression results for hernia repair patients can be found in table 4 (results for individual years are reported in tables A13-A18 in the appendix). Death following admission for hernia repair is uncommon, the proportion falling from 0.19% in 2002/3 to 0.16% in 2007/8 (figure 1). The improvement in survival over time is reflected in the increasingly positive coefficients for the year dummies. Yet there are patient-related factors associated with the probability of dying in hospital.

Table 3 Survival and readmission results for hip replacement spells, 2002/03-2007/08 pooled

	(1) Sample selection model probit survival for hip spells 2002/03-2007/08	(2) Sample selection model probit survival for hip spells 2002/03-2007/08	(3) Sample selection model probit readmission for hip spells 2002/03-2007/08	(4) Sample selection model probit readmission for hip spells 2002/03-2007/08	(5) No sample selection probit readmission for hip spells 2002/03-2007/08	(6) No sample selection probit readmission for hip spells 2002/03-2007/08
VARIABLES	average marginal effect	stamdard error	average marginal effect	stamdard error	average marginal effect	stamdard error
Patient level variables						
Age 1-63 years	0.005***	[0.001]	-0.006***	[0.001]	-0.006***	[0.001]
Age 72-77 years	-0.013***	[0.001]	0.008***	[0.001]	0.008***	[0.001]
Age 78 -83 years	-0.027***	[0.002]	0.018***	[0.001]	0.017***	[0.001]
Age over 84 years	-0.051***	[0.002]	0.034***	[0.002]	0.028***	[0.002]
Male	-0.014***	[0.001]	0.015***	[0.001]	0.014***	[0.001]
Charlson index=1	-0.019***	[0.001]	0.017***	[0.001]	0.015***	[0.001]
Charlson index=2	-0.045***	[0.002]	0.003	[0.002]	-0.003*	[0.002]
Hip fracture dummy	0.001	[0.002]	-0.030***	[0.002]	-0.029***	[0.002]
Partial hip replacement dummy	-0.021***	[0.002]	0.000	[0.002]	-0.003	[0.002]
Revision dummy	0.001	[0.001]	0.023***	[0.002]	0.023***	[0.002]
Emergency	-0.020***	[0.001]	0.052***	[0.002]	0.050***	[0.002]
Transfer in	-0.006**	[0.003]	0.014*	[0.008]	0.013*	[0.008]
Transfer out			-0.010*	[0.006]	-0.009*	[0.005]
No. of diagnoses	-0.006***	[0.000]	0.005***	[0.000]	0.004***	[0.000]
No. of procedures	-0.002***	[0.000]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.003***	[0.001]	-0.005***	[0.002]	-0.004***	[0.002]
IMD Quintile 3	0.004***	[0.001]	-0.010***	[0.002]	-0.009***	[0.002]
IMD Quintile 4	0.006***	[0.001]	-0.016***	[0.002]	-0.015***	[0.002]
IMD Quintile 5 (least deprived)	0.005***	[0.001]	-0.015***	[0.002]	-0.014***	[0.002]
IMD Unknown	0.008***	[0.003]	-0.056***	[0.005]	-0.053***	[0.005]
Sunday admission	-0.000	[0.001]				
Monday admission	-0.000	[0.001]				
Tuesday admission	0.000	[0.001]				
Wednesday admission	0.000	[0.001]				
Thursday admission	0.002**	[0.001]				
Friday admission	-0.000	[0.001]				
Christmas admission	-0.001	[0.004]				
Easter admission	-0.001	[0.005]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.038***	[0.013]	-0.019	[0.018]	-0.021	[0.017]
Teaching hospital	0.001	[0.002]	0.001	[0.004]	0.001	[0.004]
Specialist hospital	0.018***	[0.004]	-0.005	[0.008]	-0.005	[0.008]
London hospital	-0.004*	[0.002]	-0.004	[0.003]	-0.004	[0.003]
FCEs s.t.PbR	0.002	[0.002]	-0.001	[0.005]	-0.001	[0.005]
year2003	0.002***	[0.001]	-0.001	[0.002]	-0.001	[0.002]
year2004	0.005***	[0.001]	-0.000	[0.002]	0.000	[0.002]
year2005	0.008***	[0.001]	0.000	[0.003]	0.001	[0.002]
year2006	0.011***	[0.002]	0.003	[0.003]	0.004	[0.003]
year2007	0.016***	[0.002]	-0.004	[0.004]	-0.002	[0.004]
Observations	496,366		496,366		478,008	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.264 (SE=0.045); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 31.67 Prob > chi2 = 0.0000; (iv) standard errors are estimated with clustering by hospital.

Table 4 Survival and readmission results for hernia repair spells, 2002/03-2007/08 pooled

	(1) Sample selection model probit survival for hernia spells 2002/03-2007/08	(2) Sample selection model probit survival for hernia spells 2002/03-2007/08	(3) Sample selection model probit readmission for hernia spells 2002/03-2007/08	(4) Sample selection model probit readmission for hernia spells 2002/03-2007/08	(5) No sample selection probit readmission for hernia spells 2002/03-2007/08	(6) No sample selection probit readmission for hernia spells 2002/03-2007/08
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years	0.001	[0.000]	-0.002**	[0.001]	-0.002**	[0.001]
Age 57-65 years	-0.001*	[0.001]	0.004***	[0.001]	0.004***	[0.001]
Age 66-74 years	-0.003***	[0.001]	0.012***	[0.001]	0.012***	[0.001]
Age over 75 years	-0.004***	[0.001]	0.027***	[0.001]	0.025***	[0.001]
Male	0.000	[0.000]	0.003***	[0.001]	0.003***	[0.001]
Charlson index=1	-0.001***	[0.000]	0.002***	[0.001]	0.002***	[0.001]
Charlson index=2	-0.002***	[0.000]	-0.000	[0.001]	-0.003***	[0.001]
Inguinal hernia: other diagnosis	-0.001*	[0.000]	0.010***	[0.001]	0.009***	[0.001]
Inguinal hernia: bilateral diagnosis	-0.001***	[0.000]	0.003**	[0.001]	-0.001	[0.001]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.005***	[0.001]	-0.003***	[0.001]
Comorbidity: connective tissue disorder	0.001***	[0.000]	-0.005***	[0.001]	-0.003***	[0.001]
Laparoscopic repair	0.000	[0.000]	-0.000	[0.001]	-0.000	[0.001]
Presence of implant	0.001***	[0.000]	-0.005***	[0.001]	-0.005***	[0.001]
Emergency	-0.003***	[0.000]	0.035***	[0.002]	0.031***	[0.002]
Transfer in	-0.001*	[0.000]	0.010**	[0.004]	0.008*	[0.004]
Transfer out			0.004*	[0.003]	0.004	[0.003]
No. of diagnoses	-0.000***	[0.000]	0.005***	[0.000]	0.004***	[0.000]
No. of procedures	-0.000***	[0.000]	0.002***	[0.000]	0.001***	[0.000]
IMD Quintile 2	0.000*	[0.000]	-0.005***	[0.001]	-0.004***	[0.001]
IMD Quintile 3	0.000**	[0.000]	-0.005***	[0.001]	-0.005***	[0.001]
IMD Quintile 4	0.000**	[0.000]	-0.008***	[0.001]	-0.007***	[0.001]
IMD Quintile 5 (least deprived)	0.000**	[0.000]	-0.008***	[0.001]	-0.008***	[0.001]
IMD Unknown	0.001***	[0.000]	-0.012***	[0.001]	-0.011***	[0.001]
Sunday admission	-0.000	[0.000]				
Monday admission	0.000	[0.000]				
Tuesday admission	0.000	[0.000]				
Wednesday admission	0.000	[0.000]				
Thursday admission	-0.000	[0.000]				
Friday admission	0.000**	[0.000]				
Christmas admission	0.001***	[0.000]				
Easter admission	0.000	[0.001]				
Hospital level variables						
No. of acute beds	-0.000**	[0.000]	0.000***	[0.000]	0.000***	[0.000]
Bed occupancy rate	-0.003**	[0.001]	-0.001	[0.007]	-0.003	[0.007]
Teaching hospital	0.000	[0.000]	0.001	[0.001]	0.001	[0.001]
Specialist hospital			-0.010**	[0.004]	-0.009*	[0.005]
London hospital	-0.000	[0.000]	-0.002***	[0.001]	-0.002***	[0.001]
FCEs s.t. PbR rate	-0.000	[0.000]	-0.002	[0.002]	-0.002	[0.002]
year2003	0.000	[0.000]	0.000	[0.001]	0.001	[0.001]
year2004	0.000**	[0.000]	0.002*	[0.001]	0.002**	[0.001]
year2005	0.000**	[0.000]	0.002**	[0.001]	0.002**	[0.001]
year2006	0.001***	[0.000]	0.001	[0.001]	0.002	[0.001]
year2007	0.001***	[0.000]	0.001	[0.002]	0.002	[0.002]
Observations	413,717		413,717		413,049	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.902 (SE=0.021); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 181.79 Prob > chi2 = 0.0000; (iv) standard errors are estimated with clustering by hospital.

The probability of hospital survival decreases with age. But the small number of deaths means that age effects are not always significant when the data are analysed by year. There is also weak evidence ($p<0.05$) of a socio-economic effect, those from more affluent areas having a higher survival probability (this gradient is strongly significant ($p<0.001$) only for 2006/7 (see table A17 in the appendix)).

Those admitted as emergencies are less likely to survive, and survival is also negatively correlated with the Charlson co-morbidity dummies, the number of recorded diagnoses, the number of procedures performed, and the presence of a bilateral diagnosis of hernia (the reference group is those with a unilateral or unspecified inguinal hernia). The probability of survival is higher for both those diagnosed with hypertension and those with connective tissue disorder, and for those having an implant of reinforcing mesh to facilitate skin growth.

There is no relationship between survival and the day of admission, with the exception of those admitted on a Friday who are more likely ($p<0.05$) to survive, as are those admitted over Christmas (though this is significant only when data are pooled across years).

Survival is less likely in larger hospitals and those with greater bed occupancy (both $p<0.05$), though this does not always hold for the analyses by each year. Survival appears unrelated to other hospital characteristics, although in 2005/6 we observe a higher probability ($p<0.05$) of survival in hospitals earning a higher proportion of income from PbR.

Hernia repair: readmissions

Given that the likelihood of dying in hospital is so low following admission for hernia repair, there is little difference between the coefficients associated with readmission for models that do or do not account for the probability of survival (compare the regression coefficients in columns (3) and (5) in table 4). We find that the probability of readmission increases with age, is greater for men, and is higher for people living in areas of greater income deprivation. The probability of readmission is also greater for those originally admitted as an emergency and for more complex patients (as reflected in our two Charlson co-morbidity dummies). It is also positively associated with counts of the number of diagnoses and procedures. Compared to the reference group (those with a unilateral or unspecified inguinal hernia), the likelihood of readmission is higher for those with a bilateral inguinal hernia or “other” inguinal hernia diagnoses but lower for those with a diagnosis of hypertension, connective tissue disorder and those who had a mesh implant.

Those treated originally in larger hospitals face a higher probability [AME=0.00000325] of readmission (though this variable is only significant in 2006/7 when undertaking the analysis on a year-by-year basis). The probability of readmission is lower for patients treated in specialist or London hospitals but, again, these effects do not always prove statistically significant when analysing the data by year. There is no clear trend in readmission rates over time.

5.3 Does hospital funding have an impact on quality?

We have estimated pooled and six annual cross-section survival and readmission models for three conditions. We included a measure of the proportion of hospital activity subject to PbR in all of these 42 models except those estimated across the first of our study years (2002/03). The PbR variable was statistically insignificant in both the survival and readmission models estimated across the pooled dataset for each of the three study conditions. The PbR variable was also statistically insignificant in all ten of the annual cross-section survival/readmission models for hip replacement patients, and it was statistically insignificant in nine of the ten annual cross-section survival/readmission models for stroke patients. It was statistically insignificant in eight of the ten annual cross-section survival/readmission models for hernia patients. Of the three significant

coefficients on our PbR measure, all occur in the survival equation. Two of these significant coefficients are negative (both occur in 2007/08 with one for stroke and another for hernia) and the other is positive (this occurs in the hernia model for 2005/06).

Taken together these results suggest that, for the selected conditions, PbR had no impact on readmissions. They also suggest that PbR had little impact on survival although there is some evidence of an early improvement in survival (for hernia patients in 2005/06) but that this was followed by a deterioration (for stroke and hernia patients in 2007/08).

6. Discussion

The introduction of PbR was intended to provide financial incentives for hospitals to increase activity whilst competing on quality rather than price. We have explored two measures of quality, mortality and number of emergency readmissions, which reflect the success of the care delivered and the appropriateness of the resources devoted to that care. A fixed per case payment gives a strong incentive for hospitals to reduce length of stay to increase throughput and to reduce costs, and emergency readmissions may result from inappropriate early discharge.

It has also been argued that PbR might lead hospitals to admit patients with less need for a procedure in order to increase income (Miraldo, Goddard and Smith, 2006). Such patients with less severe presentations of a condition would be less likely to be readmitted, and while their care might be of good quality, its appropriateness could be questioned. Of the conditions analysed here, stroke, which in 95% of cases was an emergency admission, is not subject to such influence by the hospital. The issue of demand generation might be more relevant to elective admissions for hip replacement and hernia repair. However, the proportion of income from PbR had no significant influence on readmission rates for these conditions, and no clear temporal trend in readmissions for these conditions was observed. Our analysis therefore did not produce any evidence of inappropriate admissions.

To gain Foundation Trust status hospitals had to meet a series of financial and clinical performance criteria. It might therefore be expected that FT hospitals would provide a better quality of service than hospitals which had not passed the relevant tests. FTs from the outset obtained a higher proportion of their income from PbR. But our analysis of stroke, hip replacement and hernia repair did not reveal any significant influence of PbR on the probability of emergency readmission. We also found no evidence of a PbR effect on the probability of survival in any of the three pooled models. We did find some evidence of an effect in three of the fifteen cross-section models that we estimated: we found a positive significant effect on survival for hernia patients in 2005/06, but a negative significant effect on survival for both hernia and stroke patients in 2007/08. One interpretation of the first result might note that the first FTs were the best performing and so the positive coefficient on PbR in the survival model for hernia reflects this better performance. However, it is not obvious why this better performance is not linked to PbR for the two other conditions studied. The negative significant coefficient on PbR in the survival model for both hernia and stroke patients in 2007/08 might reflect the anticipated quality effect of PbR but, if so, it is not obvious why there is no effect on readmissions, and also why there is no effect on survival for hip replacement patients.

Other hospital characteristics, such as specialist or teaching status, and clinical process variables (such as the day of the week of admission), appear to be more important (at least for the survival model). A particularly strong relationship was noted between survival and the day of admission for stroke patients, with survival being significantly more likely for those admitted on weekdays as opposed to weekends. There is also evidence of poorer survival rates for stroke patients admitted at Christmas or Easter. This adds to the evidence from other studies that the quality of treatment for some acute admissions is sensitive to the availability of the appropriate staff (Hauck and Zhao, 2011). Attempts to correct the 'weekend effect' by the introduction of fully staffed 7-day working will have significant cost implications, which would need to be reflected in an adjusted PbR tariff for the relevant acute conditions to which a 7-day working week might be extended. The absence of any discernible 'weekend effect' on hip and hernia survival rates is perfectly consistent with the presence of such an effect for stroke patients. The survival of hip replacement and hernia repair patients will not be materially affected if appropriate treatment is not undertaken on the day of admission. Stroke patients, however, do require immediate diagnosis and appropriate treatment (eg

to thin or thicken the blood) if their survival chances are not to be adversely affected. Thus we would expect to see a 'weekend effect' for conditions where rapid treatment is important but no such effect for other, less time critical, conditions.

7. Concluding remarks

The overall conclusion from the analysis is that changes in the method of hospital payment in England do not appear to have influenced the quality of service. This finding is consistent with that of Farrar et al (2009), who adopt a different analytical approach to assess the relationship between hospital financing and quality. Rather, outcomes are most influenced by clinical factors, such as patient characteristics and the specialism of hospitals, rather than financial arrangements. This is to be expected in an acute condition such as stroke, in which the majority of admissions are emergencies, and hospitals have little control over demand for the service. But similar results were also obtained for conditions most likely to be elective admissions, hip replacement and hernia repair.

The situation observed over this period may no longer obtain. On the one hand, more recent developments in PbR, such as best practice tariffs, have provided further incentives to improve the quality of service. On the other, the analysis was conducted for a period in which overall NHS budgets were being increased, reducing the financial pressure on many hospital trusts. Nowadays significant productivity improvements are being required of the health care sector and this may exert negative pressure on the quality of service provision.

References

Audit Commission (2008). *The right result?: Payment by Results 2003-07*. Health National report.

Busse R, Geissler A, Aaviksoo A, Cots F, Häkkinen U, Kobel C, Mateus C, Or Z, O'Reilly J, Serdén L, Street A, Tan S S, Quentin W (2013). *BMJ,* 346 doi: http://dx.doi.org/10.1136/bmj.f3197

Cameron A, Trivedi PK (2009). *Microeconometrics Using Stata*. Stata Press: College Station, Texas.

Charlson M, Pompei P, Ales K, MacKenzie C (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal of Chronic Diseases*, 40, 373-383.

Christensen M, Previgliano I, Capparelli F, Lerman D, Lee W, Wainsztein N. (2009). Acute treatment costs of intracerebral hemorrhage and ischemic stroke in Argentina. *Acta Neurologica Scandinavica* 119(4), 246–253.

Department of Health (2002). *Reforming NHS financial flows: introducing payment by result*. London, Department of Health.

Dr Foster Intelligence. 2011. *Dr Foster Hospital Guide 2001-2011*. Dr Foster Limited: London.

Farrar S, Chalkley M, Yi D, Ma A (2010). *Payment by Results: consequences for key outcomes measures and variations across HRGs, providers and patients*. Aberdeen: Health Economics Research Unit, University of Aberdeen.

Farrar S, Sussex J, Yi D, Sutton M, Chalkley M, Scott T, Ma A (2007). *National evaluation of Payment by Results*. Aberdeen: Health Economics Research Unit, University of Aberdeen.

Farrar S, Yi D, Sutton M, Chalkley M, Sussex J, Scott A (2009). Has payment by results affected the way that English hospitals provide care? Difference-in-difference analysis. *BMJ,* 339, b3047, doi:10.1136/bmj.b3047.

Hauck K, Zhao X (2011). How dangerous is a day in hospital? A model of adverse events and length of stay for medical inpatients. *Medical Care*, 49 (12), 1068-1075.

Kahn KL, Rubenstein LV, Draper D, Kosecoff J, Rogers WH, Keeler EB, Brook RH (1990). The effects of the DRG-based prospective payment system on quality of care for hospitalized medicare patients - an introduction to the series. *JAMA-Journal of the American Medical Association*, 264(15): 1953-1955.

Kosecoff J, Kahn KL, Rogers WH, Reinisch EJ, Sherwood MJ, Rubenstein LV, Draper D, Roth CP, Chew C, Brook RH (1990). Prospective payment system and impairment at discharge - the quicker-and-sicker story revisited. *JAMA-Journal of the American Medical Association*, 264(15): 1980-1983.

Laudicella M, Donni P, Smith P (2013). Hospital readmission rates: signal of failure or success? *Journal of Health Economics*. http://dx.doi.org/10.1016/j.jhealeco.2013.06.004

Mannion R, Marini G, Street A (2008). Implementing payment by results in the English NHS: changing incentives and the role of information. *Journal of Health Organization and Management*, 22(1), 79-88.

Miraldo M, Goddard A, Smith PC (2006). The incentive effects of Payment by Results. *CHE research paper 19*, Centre for Health Economics, University of York.

NCHOD (2011). Emergency readmissions to hospital within 28 days of discharge. Indicator specification document. Prepared 10 November 2011. *Compendium of Population Health indicators.* NHS Information Centre for Health and Social Care.

Office of the Deputy Prime Minister (2004). *The English Indices of* Deprivation 2004 (revised): Her Majesty's Stationery Office, London.

Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, Saunders LD, Beck CA, Feasby TE, Ghali WA (2005). Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care*, 43(11), 1130-1139.

Rogers WH, Draper D, Kahn KL, Keeler EB, Rubenstein LV, Kosecoff J, Brook RH (1990). Quality of care before and after implementation of the DRG-based prospective payment system - a summary of effects. *JAMA-Journal of the American Medical Association*, 264(15): 1989-1994.

Street A, Miraldo M (2007). The impact of the reform of hospital funding in England. Centre for Health Economics, University of York. Paper presented at: Evaluating Health Policy: New Evidence from Administrative Data. September 2007, University of York.

Vest JR, Gamm LD, Oxford BA, Gonzalez MI, Slawson KM (2010). Determinants of preventable readmissions in the United States: a systematic review. *Implementation Science*, 5, 88.

Westert GP, Lagoe RJ, Keskimaki I, Leyland A, Murphy M (2002). An international study of hospital readmissions and related utilization in Europe and the USA. *Health Policy*, 61, 269-278.

Yam CH, Wong EL, Chan FW, Wong FY, Leung MC, Yeoh EK (2010). Measuring and preventing potentially avoidable hospital readmissions: a review of the literature. *Hong Kong Medical Journal*, 16, 383-389.

Appendix

Contents

Table A1 Survival and readmission results for stroke spells, 2002/03

	(1) Sample selection model probit survival for stroke spells 2002/03	(2) Sample selection model probit survival for stroke spells 2002/03	(3) Sample selection model probit readmission for stroke spells 2002/03	(4) Sample selection model probit readmission for stroke spells 2002/03	(5) No sample selection probit readmission for stroke spells 2002/03	(6) No sample selection probit readmission for stroke spells 2002/03
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.053***	[0.006]	0.003	[0.007]	0.010*	[0.005]
Age 71-80 years	-0.086***	[0.005]	0.016*	[0.008]	-0.001	[0.003]
Age 81-85 years	-0.161***	[0.005]	0.040***	[0.015]	0.004	[0.005]
Age over 86 years	-0.260***	[0.006]	0.057**	[0.024]	-0.001	[0.005]
Male	0.030***	[0.003]	-0.006	[0.004]	-0.000	[0.002]
Charlson index=1	-0.069***	[0.005]	0.027***	[0.008]	0.008***	[0.003]
Charlson index=2	-0.200***	[0.006]	0.051***	[0.020]	0.005	[0.005]
Pneumonia	-0.457***	[0.008]	0.129**	[0.050]	0.003	[0.006]
Intracerebral haemorrhage	-0.234***	[0.007]	0.095***	[0.024]	0.030***	[0.005]
Unspecified stroke	-0.118***	[0.006]	0.036***	[0.012]	0.008**	[0.003]
Emergency	-0.080***	[0.010]	0.062***	[0.013]	0.034***	[0.006]
Transfer in	-0.011	[0.011]	0.032**	[0.013]	0.022**	[0.009]
Transfer out			0.047***	[0.012]	0.035***	[0.010]
Hemi/paraplegia	0.026***	[0.008]	-0.015**	[0.007]	-0.007	[0.005]
No. of diagnoses	0.017***	[0.001]	-0.003	[0.002]	0.001	[0.001]
No. of procedures	-0.014***	[0.003]	0.007***	[0.002]	0.003**	[0.001]
IMD Quintile 2	-0.006	[0.004]	-0.004	[0.005]	-0.004	[0.003]
IMD Quintile 3	-0.001	[0.005]	-0.013**	[0.005]	-0.010***	[0.004]
IMD Quintile 4	-0.003	[0.005]	-0.016***	[0.006]	-0.012***	[0.004]
IMD Quintile 5 (least deprived)	0.004	[0.005]	-0.021***	[0.006]	-0.015***	[0.004]
IMD Unknown	0.080***	[0.015]	-0.112***	[0.019]	-0.066***	[0.007]
Sunday admission	-0.008	[0.006]				
Monday admission	0.013**	[0.006]				
Tuesday admission	0.011**	[0.005]				
Wednesday admission	0.010*	[0.005]				
Thursday admission	0.003	[0.005]				
Friday admission	0.012**	[0.006]				
Christmas 2002 admission	-0.062***	[0.021]				
Easter 2002 admission	-0.030	[0.021]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000*	[0.000]	0.000*	[0.000]
Bed occupancy rate	0.036	[0.062]	0.002	[0.073]	0.008	[0.052]
Teaching hospital	0.023***	[0.008]	0.001	[0.011]	0.004	[0.008]
Specialist hospital	0.030	[0.083]	0.013	[0.078]	0.014	[0.046]
London hospital	0.037***	[0.011]	-0.011	[0.008]	-0.002	[0.006]
Observations	80,861		80,861		58,479	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.517 (SE=0.118); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 12.67 Prob > chi2 = 0.0004; (iv) standard errors are estimated with clustering by hospital.

Table A2 Survival and readmission results for stroke spells, 2003/04

	(1) Sample selection model probit survival for stroke spells 2003/04	(2) Sample selection model probit survival for stroke spells 2003/04	(3) Sample selection model probit readmission for stroke spells 2003/04	(4) Sample selection model probit readmission for stroke spells 2003/04	(5) No sample selection probit readmission for stroke spells 2003/04	(6) No sample selection probit readmission for stroke spells 2003/04
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.063***	[0.005]	0.003	[0.007]	0.013***	[0.004]
Age 71-80 years	-0.069***	[0.005]	0.024***	[0.007]	0.004	[0.004]
Age 81-85 years	-0.151***	[0.006]	0.063***	[0.015]	0.014***	[0.004]
Age over 86 years	-0.241***	[0.007]	0.083***	[0.021]	0.008	[0.005]
Male	0.033***	[0.003]	-0.014***	[0.005]	-0.003	[0.003]
Charlson index=1	-0.064***	[0.004]	0.036***	[0.007]	0.013***	[0.003]
Charlson index=2	-0.186***	[0.006]	0.061***	[0.017]	0.005	[0.004]
Pneumonia	-0.442***	[0.008]	0.164***	[0.044]	0.005	[0.006]
Intracerebral haemorrhage	-0.249***	[0.007]	0.128***	[0.023]	0.039***	[0.005]
Unspecified stroke	-0.114***	[0.007]	0.045***	[0.011]	0.009**	[0.004]
Emergency	-0.087***	[0.014]	0.068***	[0.018]	0.032***	[0.010]
Transfer in	-0.015	[0.013]	0.038**	[0.019]	0.025*	[0.013]
Transfer out			0.033**	[0.013]	0.025**	[0.010]
Hemi/paraplegia	0.036***	[0.009]	-0.011	[0.009]	-0.001	[0.006]
No. of diagnoses	0.014***	[0.001]	-0.002	[0.001]	0.001*	[0.001]
No. of procedures	-0.009***	[0.003]	0.005**	[0.002]	0.002	[0.002]
IMD Quintile 2	0.000	[0.004]	-0.006	[0.006]	-0.005	[0.004]
IMD Quintile 3	0.003	[0.005]	-0.009	[0.006]	-0.006	[0.004]
IMD Quintile 4	0.001	[0.005]	-0.021***	[0.006]	-0.015***	[0.004]
IMD Quintile 5 (least deprived)	0.016**	[0.007]	-0.030***	[0.006]	-0.018***	[0.005]
IMD Unknown	0.076***	[0.015]	-0.115***	[0.015]	-0.064***	[0.006]
Sunday admission	0.002	[0.006]				
Monday admission	0.019***	[0.005]				
Tuesday admission	0.020***	[0.006]				
Wednesday admission	0.019***	[0.005]				
Thursday admission	0.015***	[0.005]				
Friday admission	0.022***	[0.005]				
Christmas 2003 admission	-0.041*	[0.023]				
Easter 2003 admission	-0.044*	[0.024]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.010	[0.067]	-0.062	[0.082]	-0.046	[0.057]
Teaching hospital	0.030***	[0.009]	-0.003	[0.010]	0.004	[0.008]
Specialist hospital	0.053	[0.076]	-0.037	[0.065]	-0.015	[0.034]
London hospital	0.027***	[0.009]	-0.003	[0.008]	0.004	[0.006]
FCEs s.t. PbR rate	0.395	[0.477]	-0.346	[0.490]	-0.185	[0.331]
Observations	80,708		80,708		59,081	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.592 (SE=0.097); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 20.79 Prob > chi2 = 0.0000; (iv) standard errors are estimated with clustering by hospital.

Table A3 Survival and readmission results for stroke spells, 2004/05

	(1) Sample selection model probit survival for stroke spells 2004/05	(2) Sample selection model probit survival for stroke spells 2004/05	(3) Sample selection model probit readmission for stroke spells 2004/05	(4) Sample selection model probit readmission for stroke spells 2004/05	(5) No sample selection probit readmission for stroke spells 2004/05	(6) No sample selection probit readmission for stroke spells 2004/05
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.062***	[0.006]	0.004	[0.007]	0.010**	[0.005]
Age 71-80 years	-0.079***	[0.004]	0.018***	[0.007]	0.005	[0.004]
Age 81-85 years	-0.159***	[0.005]	0.030**	[0.012]	0.005	[0.005]
Age over 86 years	-0.247***	[0.006]	0.051***	[0.018]	0.010**	[0.005]
Male	0.031***	[0.003]	-0.010**	[0.004]	-0.004	[0.003]
Charlson index=1	-0.053***	[0.004]	0.019***	[0.006]	0.009***	[0.003]
Charlson index=2	-0.172***	[0.006]	0.029**	[0.014]	0.002	[0.004]
Pneumonia	-0.444***	[0.008]	0.106***	[0.040]	0.016**	[0.007]
Intracerebral haemorrhage	-0.242***	[0.006]	0.086***	[0.021]	0.037***	[0.006]
Unspecified stroke	-0.111***	[0.006]	0.028***	[0.009]	0.009***	[0.003]
Emergency	-0.086***	[0.017]	0.058***	[0.021]	0.037***	[0.014]
Transfer in	-0.007	[0.010]	0.037	[0.022]	0.029*	[0.017]
Transfer out			0.024**	[0.011]	0.019**	[0.009]
Hemi/paraplegia	0.022***	[0.008]	-0.017***	[0.006]	-0.011**	[0.005]
No. of diagnoses	0.012***	[0.001]	0.002*	[0.001]	0.003***	[0.001]
No. of procedures	-0.010***	[0.003]	0.003	[0.002]	0.001	[0.002]
IMD Quintile 2	0.004	[0.005]	-0.003	[0.005]	-0.002	[0.004]
IMD Quintile 3	0.008	[0.005]	-0.018***	[0.005]	-0.013***	[0.004]
IMD Quintile 4	0.008*	[0.005]	-0.023***	[0.005]	-0.017***	[0.003]
IMD Quintile 5 (least deprived)	0.019***	[0.006]	-0.025***	[0.006]	-0.018***	[0.004]
IMD Unknown	0.052***	[0.013]	-0.098***	[0.013]	-0.069***	[0.006]
Sunday admission	-0.002	[0.006]				
Monday admission	0.019***	[0.005]				
Tuesday admission	0.015***	[0.005]				
Wednesday admission	0.013**	[0.005]				
Thursday admission	0.008	[0.005]				
Friday admission	0.003	[0.005]				
Christmas 2004 admission	-0.001	[0.022]				
Easter 2004 admission	0.011	[0.016]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	0.021	[0.082]	0.043	[0.069]	0.037	[0.053]
Teaching hospital	0.023***	[0.009]	-0.006	[0.010]	-0.002	[0.008]
Specialist hospital	0.112***	[0.023]	-0.019	[0.022]	-0.003	[0.018]
London hospital	0.021**	[0.009]	0.020	[0.016]	0.019	[0.013]
FCEs s.t. PbR rate	0.010	[0.009]	-0.011	[0.008]	-0.008	[0.007]
Observations	80,866		80,866		60,433	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho= -0.396 (SE=0.117); (iii) Wald test of indep. eqns. (rho= 0): chi2(1) = 9.17 Prob > chi2 = 0.0025; (iv) all standard errors are estimated with clustering by hospital.

Table A4 Survival and readmission results for stroke spells, 2005/06

	(1) Sample selection model probit survival for stroke spells 2005/06	(2) Sample selection model probit survival for stroke spells 2005/06	(3) Sample selection model probit readmission for stroke spells 2005/06	(4) Sample selection model probit readmission for stroke spells 2005/06	(5) No sample selection probit readmission for stroke spells 2005/06	(6) No sample selection probit readmission for stroke spells 2005/06
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.057***	[0.006]	0.006	[0.007]	0.014***	[0.005]
Age 71-80 years	-0.069***	[0.005]	0.020**	[0.009]	0.002	[0.004]
Age 81-85 years	-0.142***	[0.005]	0.050***	[0.016]	0.009**	[0.005]
Age over 86 years	-0.215***	[0.006]	0.078***	[0.025]	0.012**	[0.005]
Male	0.034***	[0.003]	-0.008*	[0.005]	0.001	[0.002]
Charlson index=1	-0.060***	[0.004]	0.037***	[0.008]	0.016***	[0.003]
Charlson index=2	-0.144***	[0.005]	0.053***	[0.017]	0.009**	[0.004]
Pneumonia	-0.336***	[0.006]	0.130***	[0.043]	0.013**	[0.006]
Intracerebral haemorrhage	-0.200***	[0.005]	0.110***	[0.024]	0.046***	[0.005]
Unspecified stroke	-0.090***	[0.006]	0.044***	[0.011]	0.015***	[0.004]
Emergency	-0.069***	[0.012]	0.048***	[0.014]	0.022***	[0.007]
Transfer in	0.005	[0.009]	0.001	[0.011]	0.003	[0.008]
Transfer out			0.016	[0.011]	0.013	[0.009]
Hemi/paraplegia	0.015	[0.010]	-0.018**	[0.007]	-0.010**	[0.004]
No. of diagnoses	0.011***	[0.001]	-0.000	[0.001]	0.002***	[0.001]
No. of procedures	-0.005**	[0.002]	0.001	[0.002]	0.000	[0.002]
IMD Quintile 2	-0.002	[0.004]	-0.006	[0.005]	-0.004	[0.004]
IMD Quintile 3	0.006	[0.005]	-0.014**	[0.006]	-0.009**	[0.004]
IMD Quintile 4	-0.004	[0.005]	-0.017***	[0.006]	-0.013***	[0.004]
IMD Quintile 5 (least deprived)	0.003	[0.005]	-0.029***	[0.007]	-0.020***	[0.004]
IMD Unknown	0.020	[0.015]	-0.137***	[0.029]	-0.067***	[0.008]
Sunday admission	-0.002	[0.005]				
Monday admission	0.023***	[0.005]				
Tuesday admission	0.020***	[0.005]				
Wednesday admission	0.016***	[0.005]				
Thursday admission	0.016***	[0.004]				
Friday admission	0.010**	[0.005]				
Christmas 2005 admission	-0.001	[0.022]				
Easter 2005 admission	0.000	[0.000]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000***	[0.000]	0.000***	[0.000]
Bed occupancy rate	0.042	[0.053]	0.050	[0.063]	0.047	[0.048]
Teaching hospital	0.021**	[0.009]	-0.019*	[0.011]	-0.010	[0.008]
Specialist hospital	0.092**	[0.043]	0.034	[0.026]	0.045**	[0.020]
London hospital	0.025***	[0.007]	0.022	[0.015]	0.023*	[0.013]
FCEs s.t. PbR rate	0.013	[0.009]	-0.005	[0.009]	-0.001	[0.006]
Observations	80,770		80,770		60,969	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho= -0.563 (SE=0.133); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 10.69 Prob > chi2 = 0.0011; (iv) standard errorrs are estimated with clustering by hospital.

Table A5 Survival and readmission results for stroke spells, 2006/07

	(1) Sample selection model probit survival for stroke spells 2006/07	(2) Sample selection model probit survival for stroke spells 2006/07	(3) Sample selection model probit readmission for stroke spells 2006/07	(4) Sample selection model probit readmission for stroke spells 2006/07	(5) No sample selection probit readmission for stroke spells 2006/07	(6) No sample selection probit readmission for stroke spells 2006/07
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Age 1-60 years	0.040***	[0.006]	-0.007	[0.006]	-0.003	[0.004]
Age 71-80 years	-0.076***	[0.004]	0.007	[0.006]	-0.001	[0.004]
Age 81-85 years	-0.152***	[0.005]	0.025**	[0.012]	0.007	[0.005]
Age over 86 years	-0.246***	[0.006]	0.044**	[0.019]	0.012**	[0.005]
Male	0.032***	[0.003]	-0.006	[0.004]	-0.002	[0.003]
Charlson index=1	-0.054***	[0.004]	0.024***	[0.006]	0.015***	[0.003]
Charlson index=2	-0.151***	[0.006]	0.027**	[0.011]	0.007*	[0.004]
Pneumonia	-0.417***	[0.008]	0.072**	[0.033]	0.010	[0.007]
Intracerebral haemorrhage	-0.220***	[0.007]	0.079***	[0.018]	0.043***	[0.005]
Unspecified stroke	-0.082***	[0.007]	0.021***	[0.008]	0.009**	[0.004]
Emergency	-0.072***	[0.011]	0.041***	[0.010]	0.028***	[0.007]
Transfer in	-0.012	[0.010]	0.015	[0.012]	0.012	[0.010]
Transfer out			0.025**	[0.011]	0.021**	[0.009]
Hemi/paraplegia	0.014*	[0.008]	-0.008	[0.007]	-0.006	[0.006]
No. of diagnoses	0.007***	[0.001]	0.001	[0.001]	0.001**	[0.001]
No. of procedures	0.012***	[0.002]	-0.002	[0.002]	-0.001	[0.001]
IMD Quintile 2	0.013***	[0.004]	-0.006	[0.005]	-0.004	[0.004]
IMD Quintile 3	0.011**	[0.004]	-0.016***	[0.006]	-0.013***	[0.005]
IMD Quintile 4	0.014***	[0.005]	-0.015***	[0.006]	-0.011**	[0.005]
IMD Quintile 5 (least deprived)	0.016***	[0.005]	-0.022***	[0.006]	-0.016***	[0.005]
IMD Unknown	0.046***	[0.013]	-0.071***	[0.016]	-0.055***	[0.012]
Sunday admission	0.003	[0.005]				
Monday admission	0.022***	[0.004]				
Tuesday admission	0.019***	[0.005]				
Wednesday admission	0.022***	[0.005]				
Thursday admission	0.018***	[0.005]				
Friday admission	0.023***	[0.005]				
Christmas 2006 admission	-0.048**	[0.020]				
Easter 2006 admission	-0.018	[0.019]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000*	[0.000]	0.000*	[0.000]
Bed occupancy rate	-0.068	[0.058]	0.098	[0.092]	0.075	[0.081]
Teaching hospital	0.009	[0.009]	-0.020	[0.013]	-0.016	[0.011]
Specialist hospital	0.050*	[0.026]	-0.022	[0.023]	-0.014	[0.018]
London hospital	0.034***	[0.009]	0.026**	[0.013]	0.026**	[0.012]
FCEs s.t. PbR rate	-0.005	[0.011]	-0.003	[0.012]	-0.003	[0.010]
Observations	78,501		78,501		60,089	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.326 (SE=0.117); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 6.66 Prob > chi2 = 0.0099; (iv) all standard errors are estimated with clustering by hospital.

Table A6 Survival and readmission results for stroke spells, 2007/08

	(1) Sample selection model probit survival for stroke spells 2007/08	(2) Sample selection model probit survival for stroke spells 2007/08	(3) Sample selection model probit readmission for stroke spells 2007/08	(4) Sample selection model probit readmission for stroke spells 2007/08	(5) No sample selection probit readmission for stroke spells 2007/08	(6) No sample selection probit readmission for stroke spells 2007/08
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-60 years	0.042***	[0.005]	0.011**	[0.005]	0.012***	[0.004]
Age 71-80 years	-0.064***	[0.005]	0.005	[0.006]	-0.002	[0.004]
Age 81-85 years	-0.136***	[0.006]	0.029***	[0.011]	0.010**	[0.005]
Age over 86 years	-0.220***	[0.006]	0.041**	[0.017]	0.010**	[0.005]
Male	0.030***	[0.003]	-0.004	[0.003]	-0.000	[0.002]
Charlson index=1	-0.051***	[0.004]	0.014***	[0.005]	0.006**	[0.003]
Charlson index=2	-0.137***	[0.005]	0.014	[0.010]	-0.003	[0.004]
Pneumonia	-0.399***	[0.007]	0.065**	[0.032]	0.004	[0.006]
Intracerebral haemorrhage	-0.219***	[0.006]	0.066***	[0.019]	0.030***	[0.005]
Unspecified stroke	-0.071***	[0.006]	0.023***	[0.007]	0.011***	[0.004]
Emergency	-0.076***	[0.009]	0.043***	[0.011]	0.028***	[0.007]
Transfer in	0.003	[0.007]	0.028**	[0.014]	0.024**	[0.012]
Transfer out			0.022***	[0.008]	0.019***	[0.007]
Hemi/paraplegia	0.010	[0.007]	-0.008	[0.006]	-0.006	[0.005]
No. of diagnoses	0.006***	[0.001]	0.003***	[0.001]	0.003***	[0.001]
No. of procedures	0.018***	[0.001]	-0.005***	[0.002]	-0.002**	[0.001]
IMD Quintile 2	0.003	[0.004]	-0.010**	[0.005]	-0.008**	[0.004]
IMD Quintile 3	0.001	[0.005]	-0.020***	[0.005]	-0.017***	[0.004]
IMD Quintile 4	0.004	[0.005]	-0.017***	[0.005]	-0.014***	[0.004]
IMD Quintile 5 (least deprived)	0.007	[0.006]	-0.018***	[0.006]	-0.014***	[0.005]
IMD Unknown	0.035**	[0.015]	-0.084***	[0.012]	-0.065***	[0.006]
Sunday admission	0.003	[0.005]				
Monday admission	0.021***	[0.005]				
Tuesday admission	0.025***	[0.005]				
Wednesday admission	0.027***	[0.005]				
Thursday admission	0.022***	[0.004]				
Friday admission	0.020***	[0.005]				
Christmas 2007 admission	-0.056**	[0.022]				
Easter 2007 admission	-0.026	[0.016]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.061	[0.047]	-0.014	[0.043]	-0.019	[0.034]
Teaching hospital	0.015*	[0.008]	-0.003	[0.009]	-0.001	[0.007]
Specialist hospital	0.096***	[0.026]	-0.036	[0.027]	-0.022	[0.021]
London hospital	0.025***	[0.009]	0.005	[0.009]	0.007	[0.007]
FCEs s.t. PbR rate	-0.029*	[0.016]	0.002	[0.017]	-0.001	[0.014]
Observations	78,559		78,559		60,643	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.354 (SE=0.124); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 6.77 Prob > chi2 = 0.0093; (iv) all standard errors are estimated with clustering by hospital.

Table A7 Survival and readmission results for hip replacement spells, 2002/03

	(1) Sample selection model probit survival hip replacement spells 2002/03	(2) Sample selection model probit survival hip replacement spells 2002/03	(3) Sample selection model probit readmission hip replacement spells 2002/03	(4) Sample selection model probit readmission hip replacement spells 2002/03	(5) No sample selection probit readmission hip replacement spells 2002/03	(6) No sample selection probit readmission hip replacement spells 2002/03
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.006	[0.004]	-0.006*	[0.003]	-0.006*	[0.003]
Age 72-77 years	-0.019***	[0.004]	0.012***	[0.003]	0.011***	[0.003]
Age 78 -83 years	-0.035***	[0.004]	0.021***	[0.003]	0.019***	[0.003]
Age over 84 years	-0.062***	[0.005]	0.034***	[0.005]	0.027***	[0.004]
Male	-0.016***	[0.002]	0.013***	[0.003]	0.012***	[0.003]
Charlson index=1	-0.023***	[0.002]	0.018***	[0.004]	0.016***	[0.003]
Charlson index=2	-0.053***	[0.004]	0.006	[0.006]	-0.001	[0.004]
Hip fracture dummy	0.010*	[0.005]	-0.027***	[0.006]	-0.025***	[0.005]
Partial hip replacement dummy	-0.027***	[0.003]	0.006	[0.006]	0.003	[0.005]
Revision dummy	0.004	[0.004]	0.033***	[0.005]	0.033***	[0.004]
Emergency	-0.023***	[0.003]	0.039***	[0.005]	0.036***	[0.005]
Transfer in	-0.010***	[0.004]	-0.000	[0.008]	-0.001	[0.008]
Transfer out			-0.001	[0.010]	-0.001	[0.010]
No. of diagnoses	-0.007***	[0.000]	0.004***	[0.001]	0.003***	[0.001]
No. of procedures	-0.002**	[0.001]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.003	[0.002]	-0.003	[0.004]	-0.002	[0.004]
IMD Quintile 3	0.003	[0.002]	-0.009**	[0.004]	-0.008**	[0.004]
IMD Quintile 4	0.003*	[0.002]	-0.016***	[0.004]	-0.015***	[0.004]
IMD Quintile 5 (least deprived)	0.004	[0.002]	-0.012***	[0.004]	-0.011***	[0.004]
IMD Unknown	0.005	[0.008]	-0.054***	[0.005]	-0.051***	[0.005]
Sunday admission	0.001	[0.002]				
Monday admission	0.002	[0.003]				
Tuesday admission	0.006***	[0.002]				
Wednesday admission	0.003	[0.002]				
Thursday admission	0.004*	[0.002]				
Friday admission	0.002	[0.002]				
Christmas 2002 admission	-0.014	[0.009]				
Easter 2002 admission	-0.009	[0.017]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.035	[0.029]	-0.023	[0.036]	-0.024	[0.034]
Teaching hospital	0.001	[0.004]	0.000	[0.006]	0.001	[0.005]
Specialist hospital			0.008	[0.013]	0.008	[0.013]
London hospital	-0.013***	[0.005]	-0.010**	[0.004]	-0.011***	[0.004]
Observations	75,235		75,235		72,201	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.265 (SE=0.110); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 5.23 Prob > chi2 = 0.02222; (iv) standard errors are estimated with clustering by hospital.

Table A8 Survival and readmission results for hip replacement spells, 2003/04

	(1) Sample selection model probit survival hip replacement spells 2003/04	(2) Sample selection model probit survival hip replacement spells 2003/04	(3) Sample selection model probit readmission hip replacement spells 2003/04	(4) Sample selection model probit readmission hip replacement spells 2003/04	(5) No sample selection probit readmission hip replacement spells 2003/04	(6) No sample selection probit readmission hip replacement spells 2003/04
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.003	[0.004]	-0.003	[0.004]	-0.003	[0.003]
Age 72-77 years	-0.018***	[0.004]	0.009***	[0.003]	0.008***	[0.003]
Age 78 -83 years	-0.035***	[0.004]	0.017***	[0.004]	0.014***	[0.004]
Age over 84 years	-0.065***	[0.005]	0.036***	[0.006]	0.024***	[0.004]
Male	-0.016***	[0.002]	0.015***	[0.002]	0.012***	[0.002]
Charlson index=1	-0.020***	[0.002]	0.023***	[0.004]	0.020***	[0.003]
Charlson index=2	-0.054***	[0.004]	0.011*	[0.007]	-0.002	[0.004]
Hip fracture dummy	0.003	[0.004]	-0.015***	[0.005]	-0.014***	[0.005]
Partial hip replacement dummy	-0.020***	[0.003]	0.004	[0.006]	-0.001	[0.005]
Revision dummy	0.006**	[0.003]	0.035***	[0.005]	0.035***	[0.005]
Emergency	-0.020***	[0.003]	0.034***	[0.004]	0.031***	[0.004]
Transfer in	-0.006	[0.004]	0.007	[0.008]	0.006	[0.007]
Transfer out			0.008	[0.012]	0.008	[0.012]
No. of diagnoses	-0.006***	[0.000]	0.004***	[0.001]	0.002***	[0.001]
No. of procedures	-0.001	[0.001]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.001	[0.002]	-0.007**	[0.004]	-0.007*	[0.003]
IMD Quintile 3	0.004**	[0.002]	-0.012***	[0.004]	-0.011***	[0.003]
IMD Quintile 4	0.007***	[0.002]	-0.016***	[0.004]	-0.014***	[0.004]
IMD Quintile 5 (least deprived)	0.003	[0.002]	-0.016***	[0.004]	-0.015***	[0.004]
IMD Unknown	0.009	[0.006]	-0.057***	[0.008]	-0.052***	[0.008]
Sunday admission	-0.005*	[0.003]				
Monday admission	-0.003	[0.002]				
Tuesday admission	-0.004*	[0.002]				
Wednesday admission	0.001	[0.002]				
Thursday admission	-0.000	[0.003]				
Friday admission	-0.004	[0.003]				
Christmas 2003 admission	-0.010	[0.009]				
Easter 2003 admission	0.002	[0.007]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	-0.000	[0.000]	-0.000	[0.000]
Bed occupancy rate	-0.053***	[0.020]	-0.134***	[0.044]	-0.134***	[0.041]
Teaching hospital	0.003	[0.004]	0.001	[0.006]	0.002	[0.006]
Specialist hospital	0.024*	[0.012]	-0.042	[0.028]	-0.037	[0.026]
London hospital	-0.009***	[0.003]	-0.003	[0.005]	-0.005	[0.004]
FCEs s.t. PbR rate	-0.052	[0.162]	0.175	[0.245]	0.152	[0.225]
Observations	80,662		80,662		77,620	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.408 (SE=0.083); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 18.76 Prob > chi2 = 0.0000; (iv) standard errors are estimated with clustering by hospital.

Table A9 Survival and readmission results for hip replacement spells, 2004/05

	(1) Sample selection model probit survival hip replacement spells 2004/05	(2) Sample selection model probit survival hip replacement spells 2004/05	(3) Sample selection model probit readmission hip replacement spells 2004/05	(4) Sample selection model probit readmission hip replacement spells 2004/05	(5) No sample selection probit readmission hip replacement spells 2004/05	(6) No sample selection probit readmission hip replacement spells 2004/05
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.003	[0.004]	-0.002	[0.004]	-0.002	[0.004]
Age 72-77 years	-0.011***	[0.003]	0.006*	[0.004]	0.006*	[0.003]
Age 78 -83 years	-0.029***	[0.004]	0.018***	[0.004]	0.016***	[0.004]
Age over 84 years	-0.050***	[0.004]	0.037***	[0.005]	0.031***	[0.004]
Male	-0.014***	[0.002]	0.017***	[0.002]	0.015***	[0.002]
Charlson index=1	-0.020***	[0.002]	0.011***	[0.003]	0.010***	[0.003]
Charlson index=2	-0.050***	[0.003]	-0.002	[0.005]	-0.008**	[0.004]
Hip fracture dummy	0.000	[0.004]	-0.034***	[0.005]	-0.033***	[0.005]
Partial hip replacement dummy	-0.021***	[0.003]	0.012**	[0.005]	0.009*	[0.005]
Revision dummy	0.001	[0.003]	0.029***	[0.004]	0.028***	[0.004]
Emergency	-0.023***	[0.003]	0.049***	[0.005]	0.046***	[0.004]
Transfer in	-0.005	[0.005]	0.008	[0.012]	0.008	[0.011]
Transfer out			-0.016***	[0.006]	-0.015***	[0.006]
No. of diagnoses	-0.006***	[0.000]	0.005***	[0.001]	0.004***	[0.001]
No. of procedures	-0.002**	[0.001]	-0.000	[0.001]	-0.000	[0.001]
IMD Quintile 2	0.003	[0.002]	-0.001	[0.003]	-0.001	[0.003]
IMD Quintile 3	0.004*	[0.002]	-0.014***	[0.003]	-0.013***	[0.003]
IMD Quintile 4	0.007***	[0.002]	-0.015***	[0.004]	-0.014***	[0.003]
IMD Quintile 5 (least deprived)	0.004*	[0.002]	-0.013***	[0.004]	-0.012***	[0.003]
IMD Unknown	0.016***	[0.005]	-0.055***	[0.009]	-0.051***	[0.008]
Sunday admission	0.001	[0.002]				
Monday admission	0.000	[0.002]				
Tuesday admission	0.002	[0.002]				
Wednesday admission	0.001	[0.002]				
Thursday admission	0.003	[0.002]				
Friday admission	0.001	[0.002]				
Christmas 2004 admission	0.000	[0.009]				
Easter 2004 admission	-0.007	[0.009]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.062***	[0.023]	-0.012	[0.028]	-0.016	[0.026]
Teaching hospital	-0.000	[0.003]	-0.001	[0.006]	-0.001	[0.006]
Specialist hospital	0.024***	[0.007]	-0.006	[0.014]	-0.006	[0.013]
London hospital	-0.000	[0.003]	-0.007*	[0.004]	-0.006*	[0.004]
FCEs s.t. PbR rate	0.004	[0.002]	0.004	[0.005]	0.004	[0.004]
Observations	80,852		80,852		77,737	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.248 (SE=0.095); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 6.26 Prob > chi2 = 0.0123; (iv) standard errors are estimated with clustering by hospital.

Table A10 Survival and readmission results for hip replacement spells, 2005/06

	(1) Sample selection model probit survival hip replacement spells 2005/06	(2) Sample selection model probit survival hip replacement spells 2005/06	(3) Sample selection model probit readmission hip replacement spells 2005/06	(4) Sample selection model probit readmission hip replacement spells 2005/06	(5) No sample selection probit readmission hip replacement spells 2005/06	(6) No sample selection probit readmission hip replacement spells 2005/06
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.006	[0.004]	-0.006*	[0.003]	-0.006*	[0.003]
Age 72-77 years	-0.007**	[0.003]	0.008***	[0.003]	0.008***	[0.003]
Age 78 -83 years	-0.020***	[0.003]	0.019***	[0.003]	0.019***	[0.004]
Age over 84 years	-0.041***	[0.003]	0.034***	[0.004]	0.033***	[0.004]
Male	-0.016***	[0.001]	0.014***	[0.002]	0.013***	[0.002]
Charlson index=1	-0.016***	[0.002]	0.020***	[0.003]	0.020***	[0.003]
Charlson index=2	-0.034***	[0.002]	0.008*	[0.005]	0.004	[0.004]
Hip fracture dummy	0.002	[0.003]	-0.025***	[0.006]	-0.023***	[0.005]
Partial hip replacement dummy	-0.022***	[0.004]	0.002	[0.006]	0.000	[0.005]
Revision dummy	0.002	[0.003]	0.026***	[0.004]	0.027***	[0.005]
Emergency	-0.025***	[0.003]	0.043***	[0.005]	0.043***	[0.005]
Transfer in	-0.005	[0.004]	0.016	[0.011]	0.016	[0.012]
Transfer out			-0.023***	[0.006]	-0.021***	[0.005]
No. of diagnoses	-0.006***	[0.000]	0.003***	[0.001]	0.003***	[0.001]
No. of procedures	-0.003***	[0.001]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.002	[0.002]	-0.004	[0.003]	-0.004	[0.003]
IMD Quintile 3	0.001	[0.002]	-0.007**	[0.004]	-0.007**	[0.003]
IMD Quintile 4	0.004**	[0.002]	-0.016***	[0.004]	-0.015***	[0.003]
IMD Quintile 5 (least deprived)	0.004	[0.003]	-0.015***	[0.004]	-0.014***	[0.003]
IMD Unknown	0.011	[0.007]	-0.079***	[0.016]	-0.054***	[0.007]
Sunday admission	0.000	[0.002]				
Monday admission	0.002	[0.002]				
Tuesday admission	-0.003	[0.002]				
Wednesday admission	-0.004*	[0.002]				
Thursday admission	0.000	[0.002]				
Friday admission	-0.002	[0.002]				
Christmas 2005 admission	0.007	[0.009]				
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.036**	[0.018]	-0.020	[0.025]	-0.021	[0.024]
Teaching hospital	0.002	[0.004]	0.001	[0.006]	0.001	[0.006]
Specialist hospital	0.021**	[0.010]	-0.006	[0.011]	-0.005	[0.010]
London hospital	0.001	[0.002]	-0.001	[0.005]	-0.001	[0.005]
FCEs s.t. PbR rate	0.002	[0.003]	0.000	[0.006]	0.000	[0.006]
Observations	82,745		82,745		79,613	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.180 (SE=0.100); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 3.09 Prob > chi2 = 0.0788; (iv) standard errors are estimated with clustering by hospital.

Table A11 Survival and readmission results for hip replacement spells, 2006/07

	(1) Sample selection model probit survival hip replacement spells 2006/07	(2) Sample selection model probit survival hip replacement spells 2006/07	(3) Sample selection model probit readmission hip replacement spells 2006/07	(4) Sample selection model probit readmission hip replacement spells 2006/07	(5) No sample selection probit readmission hip replacement spells 2006/07	(6) No sample selection probit readmission hip replacement spells 2006/07
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.005	[0.003]	-0.013***	[0.003]	-0.012***	[0.003]
Age 72-77 years	-0.013***	[0.004]	0.004	[0.003]	0.004	[0.003]
Age 78 -83 years	-0.022***	[0.003]	0.015***	[0.003]	0.014***	[0.003]
Age over 84 years	-0.045***	[0.003]	0.026***	[0.005]	0.023***	[0.004]
Male	-0.011***	[0.001]	0.017***	[0.002]	0.016***	[0.002]
Charlson index=1	-0.015***	[0.002]	0.016***	[0.003]	0.015***	[0.003]
Charlson index=2	-0.037***	[0.003]	0.002	[0.004]	-0.001	[0.004]
Hip fracture dummy	-0.002	[0.003]	-0.035***	[0.005]	-0.034***	[0.005]
Partial hip replacement dummy	-0.023***	[0.003]	-0.001	[0.005]	-0.003	[0.004]
Revision dummy	0.003	[0.003]	0.020***	[0.004]	0.019***	[0.004]
Emergency	-0.018***	[0.002]	0.057***	[0.004]	0.056***	[0.004]
Transfer in	-0.008	[0.005]	0.012	[0.009]	0.011	[0.009]
Transfer out			-0.016***	[0.005]	-0.015***	[0.005]
No. of diagnoses	-0.006***	[0.000]	0.005***	[0.001]	0.004***	[0.000]
No. of procedures	-0.002***	[0.001]	0.001	[0.001]	0.000	[0.001]
IMD Quintile 2	0.004**	[0.002]	-0.003	[0.003]	-0.003	[0.003]
IMD Quintile 3	0.005***	[0.002]	-0.010***	[0.003]	-0.009***	[0.003]
IMD Quintile 4	0.007***	[0.002]	-0.018***	[0.003]	-0.017***	[0.003]
IMD Quintile 5 (least deprived)	0.008***	[0.002]	-0.014***	[0.003]	-0.013***	[0.003]
IMD Unknown	0.006	[0.005]	-0.049***	[0.006]	-0.047***	[0.006]
Sunday admission	-0.000	[0.002]				
Monday admission	-0.004*	[0.002]				
Tuesday admission	-0.000	[0.002]				
Wednesday admission	-0.001	[0.002]				
Thursday admission	0.001	[0.002]				
Friday admission	-0.001	[0.002]				
Christmas 2006 admission	0.011*	[0.006]				
Easter 2006 admission	0.009	[0.007]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	-0.000	[0.000]
Bed occupancy rate	-0.032	[0.020]	0.020	[0.034]	0.019	[0.033]
Teaching hospital	0.004	[0.003]	-0.004	[0.005]	-0.003	[0.005]
Specialist hospital	0.010	[0.006]	-0.011	[0.008]	-0.011	[0.008]
London hospital	-0.000	[0.003]	-0.000	[0.004]	-0.000	[0.004]
FCEs s.t. PbR	-0.000	[0.004]	-0.003	[0.007]	-0.003	[0.007]
Observations	85,554		85,554		82,482	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.151 (SE=0.101); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 2.18 Prob > chi2 = 0.1402; (iv) standard errors are estimated with clustering by hospital.

Table A12 Survival and readmission results for hip replacement spells, 2007/08

	(1) Sample selection model probit survival hip replacement spells 2007/08	(2) Sample selection model probit survival hip replacement spells 2007/08	(3) Sample selection model probit readmission hip replacement spells 2007/08	(4) Sample selection model probit readmission hip replacement spells 2007/08	(5) No sample selection probit readmission hip replacement spells 2007/08	(6) No sample selection probit readmission hip replacement spells 2007/08
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-63 years	0.009***	[0.003]	-0.007**	[0.003]	-0.007**	[0.003]
Age 72-77 years	-0.009***	[0.003]	0.010***	[0.003]	0.009***	[0.003]
Age 78 -83 years	-0.019***	[0.003]	0.020***	[0.003]	0.019***	[0.003]
Age over 84 years	-0.039***	[0.003]	0.034***	[0.005]	0.029***	[0.004]
Male	-0.011***	[0.001]	0.015***	[0.002]	0.013***	[0.002]
Charlson index=1	-0.016***	[0.002]	0.015***	[0.003]	0.014***	[0.002]
Charlson index=2	-0.036***	[0.002]	-0.006*	[0.004]	-0.009***	[0.003]
Hip fracture dummy	-0.005**	[0.002]	-0.035***	[0.004]	-0.034***	[0.004]
Partial hip replacement dummy	-0.016***	[0.002]	-0.012**	[0.005]	-0.013***	[0.004]
Revision dummy	-0.006**	[0.003]	0.012***	[0.004]	0.012***	[0.004]
Emergency	-0.018***	[0.002]	0.068***	[0.004]	0.067***	[0.004]
Transfer in	-0.002	[0.003]	0.025***	[0.009]	0.024***	[0.008]
Transfer out			-0.010**	[0.005]	-0.010**	[0.005]
No. of diagnoses	-0.005***	[0.000]	0.005***	[0.001]	0.004***	[0.000]
No. of procedures	-0.002***	[0.000]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.002	[0.002]	-0.008***	[0.003]	-0.008***	[0.003]
IMD Quintile 3	0.005***	[0.002]	-0.010***	[0.003]	-0.009***	[0.003]
IMD Quintile 4	0.004***	[0.002]	-0.017***	[0.003]	-0.016***	[0.003]
IMD Quintile 5 (least deprived)	0.006***	[0.002]	-0.021***	[0.003]	-0.020***	[0.003]
IMD Unknown	0.006	[0.004]	-0.063***	[0.008]	-0.060***	[0.007]
Sunday admission	0.003	[0.002]				
Monday admission	0.001	[0.002]				
Tuesday admission	0.001	[0.002]				
Wednesday admission	0.002	[0.002]				
Thursday admission	0.002	[0.002]				
Friday admission	0.003	[0.002]				
Christmas 2007 admission	-0.005	[0.008]				
Easter 2007 admission	0.000	[0.008]				
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.030**	[0.015]	0.008	[0.027]	0.006	[0.026]
Teaching hospital	-0.001	[0.002]	0.004	[0.006]	0.004	[0.005]
Specialist hospital	0.008	[0.007]	0.001	[0.007]	0.001	[0.007]
London hospital	-0.002	[0.002]	-0.002	[0.004]	-0.002	[0.004]
FCEs s.t. PbR	0.000	[0.005]	-0.004	[0.011]	-0.003	[0.010]
Observations	91,318		91,318		88,355	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.236 (SE=0.087); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 6.85 Prob > chi2 = 0.0089; (iv) standard errors are estimated with clustering by hospital.

Table A13 Survival and readmission results for hernia repair spells, 2002/03

	(1) Sample selection model probit survival hernia repair spells 2002/03	(2) Sample selection model probit survival hernia repair spells 2002/03	(3) Sample selection model probit readmission hernia repair spells 2002/03	(4) Sample selection model probit readmission hernia repair spells 2002/03	(5) No sample selection probit readmission hernia repair spells 2002/03	(6) No sample selection probit readmission hernia repair spells 2002/03
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years	-0.001	[0.002]	-0.005***	[0.002]	-0.005***	[0.002]
Age 57-65 years	-0.003	[0.003]	0.002	[0.002]	0.002	[0.002]
Age 66-74 years	-0.005	[0.003]	0.011***	[0.002]	0.011***	[0.002]
Age over 75 years	-0.007*	[0.004]	0.026***	[0.003]	0.024***	[0.003]
Male	-0.000	[0.001]	0.004**	[0.002]	0.004**	[0.002]
Charlson index=1	-0.001***	[0.001]	0.003	[0.002]	0.002	[0.002]
Charlson index=2	-0.003***	[0.001]	0.005	[0.003]	0.000	[0.003]
Inguinal hernia: other diagnosis	-0.000	[0.001]	0.006**	[0.002]	0.006***	[0.002]
Inguinal hernia: bilateral diagnosis	-0.002***	[0.001]	0.006*	[0.003]	0.000	[0.003]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.006***	[0.002]	-0.003**	[0.002]
Comorbidity: connective tissue disorder	0.001**	[0.000]	-0.006**	[0.003]	-0.004	[0.003]
Laparoscopic repair	-0.000	[0.001]	0.001	[0.003]	0.001	[0.002]
Presence of implant	0.001***	[0.000]	-0.006***	[0.001]	-0.005***	[0.001]
Emergency	-0.003***	[0.001]	0.024***	[0.004]	0.019***	[0.004]
Transfer in	0.001	[0.001]	0.013	[0.015]	0.016	[0.014]
Transfer out			0.003	[0.006]	0.004	[0.007]
No. of diagnoses	-0.001***	[0.000]	0.005***	[0.001]	0.003***	[0.001]
No. of procedures	-0.000	[0.000]	0.002*	[0.001]	0.001	[0.001]
IMD Quintile 2	0.000	[0.000]	-0.005***	[0.002]	-0.005***	[0.002]
IMD Quintile 3	0.000	[0.000]	-0.007***	[0.001]	-0.006***	[0.001]
IMD Quintile 4	-0.000	[0.000]	-0.006***	[0.001]	-0.006***	[0.001]
IMD Quintile 5 (least deprived)	0.000	[0.000]	-0.007***	[0.001]	-0.007***	[0.001]
IMD Unknown			-0.014***	[0.003]	-0.013***	[0.003]
Sunday admission	0.001	[0.000]				
Monday admission	0.001**	[0.000]				
Tuesday admission	0.001**	[0.000]				
Wednesday admission	0.001	[0.000]				
Thursday admission	0.001*	[0.000]				
Friday admission	0.000	[0.000]				
Christmas 2002 admission	-0.002	[0.004]				
Easter 2002 admission						
Hospital level variables						
No. of acute beds	-0.000***	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.006**	[0.003]	-0.008	[0.012]	-0.012	[0.011]
Teaching hospital	-0.000	[0.000]	-0.001	[0.002]	-0.001	[0.001]
Specialist hospital			-0.186***	[0.008]		
London hospital	0.000	[0.001]	-0.003**	[0.001]	-0.003*	[0.001]
FCEs s.t. PbR rate						
Observations	67,787		68,216		68,036	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.999 (SE=0.000); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 4.57 Prob > chi2 = 0.0325; (iv) standard errors are estimated with clustering by hospital.

Table A14 Survival and readmission results for hernia repair spells, 2003/04

	(1) Sample selection model probit survival hernia repair spells 2003/04	(2) Sample selection model probit survival hernia repair spells 2003/04	(3) Sample selection model probit readmission hernia repair spells 2003/04	(4) Sample selection model probit readmission hernia repair spells 2003/04	(5) No sample selection probit readmission hernia repair spells 2003/04	(6) No sample selection probit readmission hernia repair spells 2003/04
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years			-0.000	[0.002]	-0.000	[0.002]
Age 57-65 years	-0.011***	[0.001]	0.008***	[0.002]	0.008***	[0.002]
Age 66-74 years	-0.013***	[0.001]	0.013***	[0.003]	0.013***	[0.003]
Age over 75 years	-0.015***	[0.002]	0.028***	[0.003]	0.026***	[0.003]
Male	0.001*	[0.001]	-0.001	[0.002]	-0.000	[0.002]
Charlson index=1	-0.001**	[0.001]	0.002	[0.002]	0.002	[0.002]
Charlson index=2	-0.003***	[0.001]	-0.004*	[0.002]	-0.007***	[0.002]
Inguinal hernia: other diagnosis	-0.001*	[0.001]	0.009***	[0.002]	0.008***	[0.002]
Inguinal hernia: bilateral diagnosis	-0.002**	[0.001]	0.001	[0.003]	-0.001	[0.002]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.006***	[0.001]	-0.004***	[0.001]
Comorbidity: connective tissue disorder	0.001***	[0.000]	-0.005*	[0.003]	-0.004	[0.003]
Laparoscopic repair	0.000	[0.001]	-0.000	[0.002]	0.000	[0.002]
Presence of implant	0.000	[0.000]	-0.004***	[0.001]	-0.004***	[0.001]
Emergency	-0.003***	[0.001]	0.028***	[0.004]	0.025***	[0.004]
Transfer in	-0.006*	[0.003]	0.021	[0.014]	0.016	[0.014]
Transfer out			0.016**	[0.008]	0.016*	[0.008]
No. of diagnoses	-0.001***	[0.000]	0.005***	[0.001]	0.004***	[0.000]
No. of procedures	-0.001***	[0.000]	0.002*	[0.001]	0.001	[0.001]
IMD Quintile 2	0.001	[0.000]	-0.006***	[0.001]	-0.006***	[0.001]
IMD Quintile 3	0.001	[0.000]	-0.004**	[0.002]	-0.004**	[0.002]
IMD Quintile 4	0.000	[0.001]	-0.007***	[0.002]	-0.007***	[0.001]
IMD Quintile 5 (least deprived)	0.000	[0.001]	-0.008***	[0.001]	-0.007***	[0.001]
IMD Unknown			-0.017***	[0.002]	-0.016***	[0.002]
Sunday admission	-0.000	[0.001]				
Monday admission	-0.001	[0.001]				
Tuesday admission	-0.001	[0.001]				
Wednesday admission	0.000	[0.001]				
Thursday admission	-0.001	[0.001]				
Friday admission	0.000	[0.001]				
Christmas 2003 admission						
Easter 2003 admission						
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.004	[0.004]	-0.005	[0.014]	-0.006	[0.014]
Teaching hospital	-0.000	[0.001]	0.003	[0.002]	0.003	[0.002]
Specialist hospital			0.007	[0.022]	0.007	[0.022]
London hospital	-0.001	[0.001]	-0.001	[0.002]	-0.001	[0.002]
FCEs s.t. PbR	-0.024	[0.027]	-0.016	[0.096]	-0.028	[0.095]
Observations	55,894		70,716		70,604	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.804 (SE=0.083); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 22.18 Prob > chi2 = 0.0000; (iv) standard errors are estimated with clustering by hospital.

Table A15 Survival and readmission results for hernia repair spells, 2004/05

	(1) Sample selection model probit survival hernia repair spells 2004/05	(2) Sample selection model probit survival hernia repair spells 2004/05	(3) Sample selection model probit readmission hernia repair spells 2004/05	(4) Sample selection model probit readmission hernia repair spells 2004/05	(5) No sample selection probit readmission hernia repair spells 2004/05	(6) No sample selection probit readmission hernia repair spells 2004/05
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years			0.001	[0.002]	0.001	[0.002]
Age 57-65 years	-0.001	[0.001]	0.005**	[0.002]	0.005**	[0.002]
Age 66-74 years	-0.001	[0.001]	0.015***	[0.003]	0.016***	[0.003]
Age over 75 years	-0.003**	[0.001]	0.033***	[0.003]	0.031***	[0.003]
Male	-0.000	[0.001]	0.005***	[0.002]	0.005***	[0.002]
Charlson index=1	-0.001*	[0.001]	0.001	[0.002]	0.002	[0.002]
Charlson index=2	-0.003***	[0.001]	0.002	[0.003]	-0.002	[0.003]
Inguinal hernia: other diagnosis	0.000	[0.001]	0.010***	[0.002]	0.010***	[0.002]
Inguinal hernia: bilateral diagnosis	-0.002***	[0.001]	0.001	[0.003]	-0.003	[0.002]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.002	[0.002]	-0.001	[0.002]
Comorbidity: connective tissue disorder	0.001**	[0.000]	-0.007***	[0.002]	-0.006**	[0.002]
Laparoscopic repair	-0.000	[0.001]	0.001	[0.002]	0.001	[0.002]
Presence of implant	0.001**	[0.000]	-0.006***	[0.002]	-0.006***	[0.002]
Emergency	-0.004***	[0.001]	0.037***	[0.005]	0.033***	[0.005]
Transfer in	-0.003	[0.002]	0.017	[0.012]	0.012	[0.011]
Transfer out			-0.002	[0.003]	-0.003	[0.005]
No. of diagnoses	-0.001***	[0.000]	0.005***	[0.000]	0.004***	[0.000]
No. of procedures	-0.000	[0.000]	0.001	[0.001]	0.001	[0.001]
IMD Quintile 2	0.000	[0.000]	-0.006***	[0.002]	-0.006***	[0.001]
IMD Quintile 3	0.001	[0.001]	-0.006***	[0.001]	-0.006***	[0.001]
IMD Quintile 4	0.001	[0.000]	-0.010***	[0.001]	-0.009***	[0.001]
IMD Quintile 5 (least deprived)	0.001	[0.001]	-0.009***	[0.001]	-0.008***	[0.001]
IMD Unknown			-0.008*	[0.004]	-0.006	[0.004]
Sunday admission	0.000	[0.001]				
Monday admission	0.000	[0.001]				
Tuesday admission	0.000	[0.001]				
Wednesday admission	0.000	[0.001]				
Thursday admission	0.000	[0.001]				
Friday admission	0.001*	[0.001]				
Easter 2004 admission	-0.004	[0.004]				
Christmas 2004 admission						
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.007**	[0.003]	-0.029**	[0.014]	-0.033**	[0.014]
Teaching hospital	-0.000	[0.001]	0.006**	[0.002]	0.006***	[0.002]
Specialist hospital			-0.021***	[0.001]		
London hospital	0.000	[0.001]	-0.004***	[0.002]	-0.004***	[0.001]
FCEs s.t. PbR rate	-0.001	[0.000]	-0.003	[0.003]	-0.003	[0.002]
Observations	54,348		68,673		68,503	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.9999 (SE=0.00004); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 2.04 Prob > chi2 = 0.1532; (iv) standard errors are estimated with clustering by hospital.

Table A16 Survival and readmission results for hernia repair spells, 2005/06

	(1) Sample selection model probit survival hernia repair spells 2005/06	(2) Sample selection model probit survival hernia repair spells 2005/06	(3) Sample selection model probit readmission hernia repair spells 2005/06	(4) Sample selection model probit readmission hernia repair spells 2005/06	(5) No sample selection probit readmission hernia repair spells 2005/06	(6) No sample selection probit readmission hernia repair spells 2005/06
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years			-0.001	[0.002]	-0.001	[0.002]
Age 57-65 years	-0.002	[0.001]	0.004*	[0.002]	0.003*	[0.002]
Age 66-74 years	-0.002	[0.001]	0.011***	[0.002]	0.011***	[0.002]
Age over 75 years	-0.004***	[0.001]	0.027***	[0.003]	0.025***	[0.003]
Male	0.000	[0.001]	0.005**	[0.002]	0.005***	[0.002]
Charlson index=1	-0.001**	[0.000]	-0.000	[0.002]	0.000	[0.002]
Charlson index=2	-0.002***	[0.000]	0.000	[0.003]	-0.002	[0.003]
Inguinal hernia: other diagnosis	-0.002***	[0.001]	0.012***	[0.003]	0.011***	[0.003]
Inguinal hernia: bilateral diagnosis	-0.001***	[0.000]	0.002	[0.003]	-0.001	[0.002]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.005***	[0.001]	-0.004**	[0.001]
Comorbidity: connective tissue disorder	0.002**	[0.001]	-0.009***	[0.002]	-0.008***	[0.002]
Laparoscopic repair	-0.000	[0.001]	-0.001	[0.002]	-0.001	[0.002]
Presence of implant	0.000	[0.000]	-0.003**	[0.001]	-0.002*	[0.001]
Emergency	-0.004***	[0.001]	0.042***	[0.005]	0.035***	[0.005]
Transfer in	-0.001	[0.001]	0.004	[0.008]	0.003	[0.007]
Transfer out			0.003	[0.007]	0.006	[0.009]
No. of diagnoses	-0.001***	[0.000]	0.006***	[0.000]	0.005***	[0.000]
No. of procedures	-0.000	[0.000]	0.002**	[0.001]	0.002**	[0.001]
IMD Quintile 2	-0.000	[0.001]	-0.004**	[0.002]	-0.004**	[0.002]
IMD Quintile 3	-0.000	[0.001]	-0.003**	[0.002]	-0.004**	[0.001]
IMD Quintile 4	0.000	[0.001]	-0.008***	[0.001]	-0.008***	[0.001]
IMD Quintile 5 (least deprived)	0.000	[0.001]	-0.008***	[0.001]	-0.008***	[0.001]
IMD Unknown			-0.009	[0.006]	-0.008	[0.006]
Sunday admission	-0.001	[0.001]				
Monday admission	-0.000	[0.001]				
Tuesday admission	-0.001	[0.001]				
Wednesday admission	-0.001	[0.001]				
Thursday admission	-0.000	[0.001]				
Friday admission	0.000	[0.001]				
Christmas 2005 admission						
Easter 2005 admission						
Hospital level variables						
No. of acute beds	-0.000	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.004	[0.003]	0.008	[0.011]	0.006	[0.010]
Teaching hospital	0.001	[0.001]	0.001	[0.002]	0.001	[0.002]
Specialist hospital			-0.007	[0.006]	-0.005	[0.007]
London hospital	0.001	[0.001]	-0.003**	[0.001]	-0.003**	[0.001]
FCEs s.t. PbR rate	0.001**	[0.001]	-0.002	[0.002]	-0.002	[0.002]
Observations	54,446		68,665		68,541	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.99997 (SE=0.0003); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 1.17 Prob > chi2 = 0.2801; (iv) standard errors are estimated with clustering by hospital.

Table A17 Survival and readmission results for hernia repair spells, 2006/07

	(1) Sample selection model probit survival hernia repair spells 2006/07	(2) Sample selection model probit survival hernia repair spells 2006/07	(3) Sample selection model probit readmission hernia repair spells 2006/07	(4) Sample selection model probit readmission hernia repair spells 2006/07	(5) No sample selection probit readmission hernia repair spells 2006/07	(6) No sample selection probit readmission hernia repair spells 2006/07
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years			-0.002	[0.002]	-0.002	[0.002]
Age 57-65 years	-0.010***	[0.001]	0.006***	[0.002]	0.006***	[0.002]
Age 66-74 years	-0.012***	[0.001]	0.012***	[0.003]	0.012***	[0.002]
Age over 75 years	-0.013***	[0.001]	0.026***	[0.003]	0.024***	[0.003]
Male	0.001	[0.000]	0.003	[0.002]	0.003*	[0.002]
Charlson index=1	-0.001*	[0.000]	0.003*	[0.002]	0.004**	[0.002]
Charlson index=2	-0.001***	[0.000]	-0.000	[0.003]	-0.003	[0.003]
Inguinal hernia: other diagnosis	-0.001	[0.001]	0.007***	[0.003]	0.007***	[0.002]
Inguinal hernia: bilateral diagnosis	-0.002***	[0.000]	0.005	[0.003]	0.001	[0.003]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.004***	[0.002]	-0.003*	[0.001]
Comorbidity: connective tissue disorder	0.001*	[0.001]	-0.001	[0.002]	0.000	[0.002]
Laparoscopic repair	0.001	[0.001]	-0.001	[0.002]	-0.000	[0.002]
Presence of implant	0.000	[0.000]	-0.006***	[0.002]	-0.005***	[0.002]
Emergency	-0.002***	[0.000]	0.039***	[0.005]	0.036***	[0.005]
Transfer in	0.000	[0.001]	0.009	[0.009]	0.009	[0.009]
Transfer out			0.002	[0.007]	0.002	[0.008]
No. of diagnoses	-0.001***	[0.000]	0.005***	[0.000]	0.004***	[0.000]
No. of procedures	-0.000**	[0.000]	0.002**	[0.001]	0.001	[0.001]
IMD Quintile 2	0.001***	[0.001]	-0.003*	[0.002]	-0.002	[0.002]
IMD Quintile 3	0.001**	[0.000]	-0.006***	[0.001]	-0.005***	[0.001]
IMD Quintile 4	0.001*	[0.000]	-0.007***	[0.002]	-0.006***	[0.002]
IMD Quintile 5 (least deprived)	0.001**	[0.001]	-0.008***	[0.002]	-0.008***	[0.002]
IMD Unknown			-0.012***	[0.004]	-0.011***	[0.004]
Sunday admission	-0.000	[0.001]				
Monday admission	-0.000	[0.001]				
Tuesday admission	0.000	[0.001]				
Wednesday admission	-0.000	[0.001]				
Thursday admission	-0.000	[0.001]				
Friday admission	0.002**	[0.001]				
Christmas 2006 admission						
Easter 2006 admission						
Hospital level variables						
No. of acute beds	0.000	[0.000]	0.000***	[0.000]	0.000***	[0.000]
Bed occupancy rate	0.002	[0.003]	0.007	[0.015]	0.007	[0.014]
Teaching hospital	0.000	[0.000]	-0.003	[0.002]	-0.003	[0.002]
Specialist hospital			-0.007	[0.008]	-0.006	[0.009]
London hospital	-0.001**	[0.000]	-0.000	[0.002]	-0.001	[0.002]
FCEs s.t. PbR rate	-0.000	[0.001]	-0.002	[0.003]	-0.002	[0.003]
Observations	53,110		67,209		67,119	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.958 (SE=0.1741); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 0.82 Prob > chi2 = 0.3643; (iv) standard errors are estimated with clustering by hospital.

Table A18 Survival and readmission results for hernia repair spells, 2007/08

	(1) Sample selection model probit survival for hernia spells 2007/08	(2) Sample selection model probit survival for hernia spells 2007/08	(3) Sample selection model probit readmission for hernia spells 2007/08	(4) Sample selection model probit readmission for hernia spells 2007/08	(5) No sample selection probit readmission for hernia spells 2007/08	(6) No sample selection probit readmission for hernia spells 2007/08
VARIABLES	average marginal effect	standard error	average marginal effect	standard error	average marginal effect	standard error
Patient level variables						
Age 1-42 years			-0.003	[0.002]	-0.002	[0.002]
Age 57-65 years	-0.000	[0.001]	0.002	[0.002]	0.002	[0.002]
Age 66-74 years	-0.003	[0.002]	0.009***	[0.003]	0.008***	[0.003]
Age over 75 years	-0.003**	[0.001]	0.021***	[0.003]	0.020***	[0.003]
Male	0.000	[0.000]	0.001	[0.002]	0.001	[0.002]
Charlson index=1	-0.001	[0.000]	0.004*	[0.002]	0.005**	[0.002]
Charlson index=2	-0.002***	[0.001]	-0.002	[0.002]	-0.005**	[0.002]
Inguinal hernia: other diagnosis	0.000	[0.001]	0.014***	[0.003]	0.014***	[0.003]
Inguinal hernia: bilateral diagnosis	-0.001	[0.001]	0.003	[0.003]	0.000	[0.003]
Comorbidity: hypertension dummy	0.001***	[0.000]	-0.006***	[0.001]	-0.005***	[0.001]
Comorbidity: connective tissue disorder	0.001	[0.000]	-0.002	[0.002]	-0.001	[0.002]
Laparoscopic repair	0.001	[0.001]	-0.001	[0.002]	0.000	[0.002]
Presence of implant	0.001	[0.000]	-0.007***	[0.001]	-0.006***	[0.001]
Emergency	-0.005***	[0.001]	0.045***	[0.005]	0.039***	[0.005]
Transfer in	0.000	[0.001]	-0.002	[0.006]	-0.003	[0.005]
Transfer out			-0.001	[0.006]	-0.001	[0.006]
No. of diagnoses	-0.000***	[0.000]	0.005***	[0.000]	0.004***	[0.000]
No. of procedures	-0.000***	[0.000]	0.003***	[0.001]	0.002***	[0.001]
IMD Quintile 2	0.000	[0.000]	-0.004***	[0.002]	-0.004***	[0.002]
IMD Quintile 3	0.001	[0.000]	-0.006***	[0.002]	-0.006***	[0.002]
IMD Quintile 4	0.001**	[0.000]	-0.009***	[0.001]	-0.008***	[0.001]
IMD Quintile 5 (least deprived)	0.000	[0.001]	-0.008***	[0.002]	-0.008***	[0.002]
IMD Unknown	0.001	[0.001]	-0.014***	[0.003]	-0.014***	[0.003]
Sunday admission	0.000	[0.001]				
Monday admission	0.001	[0.001]				
Tuesday admission	0.000	[0.001]				
Wednesday admission	0.000	[0.001]				
Thursday admission	-0.000	[0.001]				
Friday admission	0.000	[0.001]				
Easter admission						
Christmas admission						
Hospital level variables						
No. of acute beds	-0.000**	[0.000]	0.000	[0.000]	0.000	[0.000]
Bed occupancy rate	-0.002	[0.003]	0.018	[0.013]	0.016	[0.012]
Teaching hospital	0.001***	[0.000]	-0.000	[0.002]	0.000	[0.002]
Specialist hospital			-0.014**	[0.006]	-0.012**	[0.005]
London hospital	-0.001	[0.001]	-0.002	[0.002]	-0.002	[0.002]
FCEs s.t. PbR rate	-0.002*	[0.001]	-0.002	[0.004]	-0.003	[0.004]
Observations	55,865		70,238		70,130	

Notes: (i) *** p<0.01, ** p<0.05, * p<0.1; (ii) rho=-0.999997 (SE=0.0000312); (iii) Wald test of indep. eqns. (rho = 0): chi2(1) = 1.77 Prob > chi2 = 0.1836; (iv) standard errors are estimated with clustering by hospital.

Table A19 Descriptive statistics for variables employed in the stroke regression models for 2002/03

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	83,018	0.724	0.447	0	1
Re-admitted	60,113	0.083	0.276	0	1
Age 1-60 years	82,938	0.132	0.338	0	1
Age 61-70 years	82,938	0.164	0.370	0	1
Age 71-80 years	82,938	0.325	0.468	0	1
Age 81-85 years	82,938	0.181	0.385	0	1
Age over 86 years	82,938	0.200	0.400	0	1
Age	82,938	74.86	13.03	1	107
Male	83,018	0.469	0.499	0	1
Charlson index=0	83,018	0.650	0.477	0	1
Charlson index=1	83,018	0.239	0.427	0	1
Charlson index=2	83,018	0.111	0.314	0	1
Pneumonia	83,018	0.082	0.274	0	1
Intracerebral haemorrhage	83,018	0.128	0.334	0	1
Cerebral infarction	83,018	0.476	0.499	0	1
Unspecified stroke	83,018	0.396	0.489	0	1
Emergency	83,018	0.940	0.237	0	1
Patient dies	83,018	0.276	0.447	0	1
Transfer in	81,779	0.068	0.252	0	1
Transfer out	81,779	0.190	0.392	0	1
Hemi/paraplegia	83,018	0.094	0.292	0	1
No. of diagnoses	83,018	4.318	2.805	1	28
No. of procedures	83,018	0.314	0.924	0	15
IMD Quintile 1	83,018	0.207	0.405	0	1
IMD Quintile 2	83,018	0.246	0.431	0	1
IMD Quintile 3	83,018	0.203	0.402	0	1
IMD Quintile 4	83,018	0.181	0.385	0	1
IMD Quintile 5 (least deprived)	83,018	0.150	0.357	0	1
IMD Quintile Unknown	83,018	0.012	0.110	0	1
Sunday admission	83,018	0.117	0.322	0	1
Monday admission	83,018	0.160	0.367	0	1
Tuesday admission	83,018	0.155	0.362	0	1
Wednesday admission	83,018	0.149	0.356	0	1
Thursday admission	83,018	0.149	0.356	0	1
Friday admission	83,018	0.145	0.352	0	1
Saturday admission	83,018	0.125	0.330	0	1
Christmas 2002 admission	83,018	0.005	0.068	0	1
Easter 2002 admission	83,018	0.000	0.000	0	0
No. of acute beds	82,119	767.347	413.200	124	2142
Bed occupancy rate	82,119	0.857	0.054	0.6858476	0.9953488
Teaching hospital	83,018	0.176	0.380	0	1
Specialist hospital	83,018	0.001	0.036	0	1
London hospital	83,018	0.123	0.329	0	1
FCEs s.t. PbR rate	83,018	0.000	0.000	0	0

Table A20 Descriptive statistics for variables employed in the stroke regression models for 2003/04

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	82,049	0.733	0.442	0	1
Re-admitted	60,170	0.087	0.282	0	1
Age 1-60 years	82,018	0.134	0.341	0	1
Age 61-70 years	82,018	0.161	0.368	0	1
Age 71-80 years	82,018	0.317	0.465	0	1
Age 81-85 years	82,018	0.188	0.391	0	1
Age over 86 years	82,018	0.199	0.399	0	1
Age	82,018	74.90	13.13	1	104
Male	82,049	0.469	0.499	0	1
Charlson index=0	82,049	0.637	0.481	0	1
Charlson index=1	82,049	0.244	0.429	0	1
Charlson index=2	82,049	0.119	0.324	0	1
Pneumonia	82,049	0.086	0.280	0	1
Intracerebral haemorrhage	82,049	0.125	0.331	0	1
Cerebral infarction	82,049	0.498	0.500	0	1
Unspecified stroke	82,049	0.377	0.485	0	1
Emergency	82,049	0.946	0.227	0	1
Patient dies	82,049	0.267	0.442	0	1
Transfer in	80,739	0.066	0.249	0	1
Transfer out	80,739	0.199	0.399	0	1
Hemi/paraplegia	82,049	0.083	0.277	0	1
No. of diagnoses	82,049	4.427	2.835	1	29
No. of procedures	82,049	0.291	0.889	0	16
IMD Quintile 1	82,049	0.206	0.405	0	1
IMD Quintile 2	82,049	0.244	0.429	0	1
IMD Quintile 3	82,049	0.205	0.404	0	1
IMD Quintile 4	82,049	0.183	0.386	0	1
IMD Quintile 5 (least deprived)	82,049	0.151	0.358	0	1
IMD Quintile Unknown	82,049	0.011	0.106	0	1
Sunday admission	82,049	0.119	0.324	0	1
Monday admission	82,049	0.161	0.368	0	1
Tuesday admission	82,049	0.154	0.361	0	1
Wednesday admission	82,049	0.150	0.357	0	1
Thursday admission	82,049	0.146	0.353	0	1
Friday admission	82,049	0.148	0.355	0	1
Saturday admission	82,049	0.123	0.328	0	1
Christmas 2003 admission	82,049	0.005	0.067	0	1
Easter 2003 admission	82,049	0.005	0.071	0	1
No. of acute beds	82,049	787.684	407.161	122	2119
Bed occupancy rate	82,049	0.859	0.053	0.7154696	0.9674267
Teaching hospital	82,049	0.172	0.377	0	1
Specialist hospital	82,049	0.001	0.035	0	1
London hospital	82,049	0.117	0.322	0	1
FCEs s.t. PbR rate	82,049	0.019	0.007	0.0009227	0.1970072

Table A21 Descriptive statistics for the variables employed in the stroke regression models for 2004/05

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	81566	0.747	0.435	0	1
Re-admitted	60894	0.090	0.287	0	1
Age 1-60 years	81527	0.143	0.350	0	1
Age 61-70 years	81527	0.164	0.370	0	1
Age 71-80 years	81527	0.305	0.460	0	1
Age 81-85 years	81527	0.195	0.396	0	1
Age over 86 years	81527	0.193	0.395	0	1
Age	81527	74.60	13.52	1	106
Male	81566	0.469	0.499	0	1
Charlson index=0	81566	0.622	0.485	0	1
Charlson index=1	81566	0.250	0.433	0	1
Charlson index=2	81566	0.128	0.335	0	1
Pneumonia	81566	0.087	0.282	0	1
Intracerebral haemorrhage	81566	0.130	0.336	0	1
Cerebral infarction	81566	0.534	0.499	0	1
Unspecified stroke	81566	0.336	0.472	0	1
Emergency	81566	0.939	0.238	0	1
Patient dies	81566	0.253	0.405	0	1
Transfer in	80905	0.072	0.259	0	1
Transfer out	80905	0.196	0.397	0	1
Hemi/paraplegia	81566	0.083	0.276	0	1
No. of diagnoses	81566	4.693	2.895	1	30
No. of procedures	81566	0.288	0.897	0	15
IMD Quintile 1	81566	0.198	0.398	0	1
IMD Quintile 2	81566	0.241	0.428	0	1
IMD Quintile 3	81566	0.212	0.409	0	1
IMD Quintile 4	81566	0.181	0.385	0	1
IMD Quintile 5 (least deprived)	81566	0.155	0.362	0	1
IMD Quintile Unknown	81566	0.013	0.111	0	1
Sunday admission	81566	0.119	0.324	0	1
Monday admission	81566	0.158	0.364	0	1
Tuesday admission	81566	0.156	0.363	0	1
Wednesday admission	81566	0.150	0.357	0	1
Thursday admission	81566	0.147	0.354	0	1
Friday admission	81566	0.147	0.354	0	1
Saturday admission	81566	0.123	0.328	0	1
Christmas 2004 admission	81566	0.005	0.067	0	1
Easter 2004 admission	81566	0.007	0.085	0	1
No. of acute beds	81566	771.287	390.932	133	2072
Bed occupancy rate	81566	0.854	0.053	0.6595744	0.9778271
Teaching hospital	81566	0.167	0.373	0	1
Specialist hospital	81566	0.002	0.044	0	1
London hospital	81566	0.124	0.330	0	1
FCEs s.t. PbR rate	81566	0.193	0.324	0.0178063	1

Table A22 Descriptive statistics for the variables employed in the stroke regression models for 2005/06

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	81382	0.756	0.430	0	1
Re-admitted	61498	0.095	0.293	0	1
Age 1-60 years	81316	0.142	0.349	0	1
Age 61-70 years	81316	0.159	0.366	0	1
Age 71-80 years	81316	0.307	0.461	0	1
Age 81-85 years	81316	0.195	0.396	0	1
Age over 86 years	81316	0.197	0.398	0	1
Age	81316	74.80	13.47	1	120
Male	81382	0.472	0.499	0	1
Charlson index=0	81382	0.600	0.490	0	1
Charlson index=1	81382	0.260	0.439	0	1
Charlson index=2	81382	0.140	0.347	0	1
Pneumonia	81382	0.093	0.290	0	1
Intracerebral haemorrhage	81379	0.135	0.342	0	1
Cerebral infarction	81379	0.566	0.496	0	1
Unspecified stroke	81379	0.298	0.457	0	1
Emergency	81379	0.947	0.225	0	1
Patient dies	81379	0.244	0.430	0	1
Transfer in	80835	0.084	0.277	0	1
Transfer out	80835	0.204	0.403	0	1
Hemi/paraplegia	81379	0.078	0.268	0	1
No. of diagnoses	81380	5.053	3.065	1	36
No. of procedures	81380	0.292	0.914	0	17
IMD Quintile 1	81382	0.199	0.399	0	1
IMD Quintile 2	81382	0.241	0.428	0	1
IMD Quintile 3	81382	0.206	0.405	0	1
IMD Quintile 4	81382	0.184	0.388	0	1
IMD Quintile 5 (least deprived)	81382	0.155	0.362	0	1
IMD Quintile Unknown	81382	0.014	0.119	0	1
Sunday admission	81382	0.119	0.323	0	1
Monday admission	81382	0.159	0.366	0	1
Tuesday admission	81382	0.154	0.361	0	1
Wednesday admission	81382	0.146	0.353	0	1
Thursday admission	81382	0.152	0.359	0	1
Friday admission	81382	0.149	0.356	0	1
Saturday admission	81382	0.122	0.327	0	1
Christmas 2005 admission	81382	0.004	0.067	0	1
Easter 2005 admission	81382	0.000	0.000	0	0
No. of acute beds	81379	766.190	388.409	79	2006
Bed occupancy rate	81379	0.849	0.058	0.632732	0.9924242
Teaching hospital	81379	0.168	0.374	0	1
Specialist hospital	81379	0.002	0.050	0	1
London hospital	81379	0.126	0.331	0	1
FCEs s.t. PbR rate	81379	0.302	0.323	0.0732839	1

Table A23 Descriptive statistics for the variables employed in the stroke regression models for 2006/07

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	79424	0.766	0.423	0	1
Re-admitted	60859	0.099	0.298	0	1
Age 1-60 years	79358	0.146	0.353	0	1
Age 61-70 years	79358	0.157	0.364	0	1
Age 71-80 years	79358	0.295	0.456	0	1
Age 81-85 years	79358	0.192	0.394	0	1
Age over 86 years	79358	0.210	0.407	0	1
Age	79,358	74.79	13.69	1	106
Male	79424	0.474	0.499	0	1
Charlson index=0	79424	0.579	0.494	0	1
Charlson index=1	79424	0.265	0.441	0	1
Charlson index=2	79424	0.156	0.363	0	1
Pneumonia	79424	0.097	0.296	0	1
Intracerebral haemorrhage	79422	0.137	0.344	0	1
Cerebral infarction	79422	0.590	0.492	0	1
Unspecified stroke	79422	0.273	0.446	0	1
Emergency	79422	0.944	0.229	0	1
Patient dies	79422	0.234	0.423	0	1
Transfer in	78571	0.085	0.279	0	1
Transfer out	78571	0.201	0.401	0	1
Hemi/paraplegia	79422	0.078	0.269	0	1
No. of diagnoses	79418	5.441	3.188	1	32
No. of procedures	79418	1.198	1.508	0	22
IMD Quintile 1	79424	0.196	0.397	0	1
IMD Quintile 2	79424	0.240	0.427	0	1
IMD Quintile 3	79424	0.203	0.402	0	1
IMD Quintile 4	79424	0.187	0.390	0	1
IMD Quintile 5 (least deprived)	79424	0.160	0.366	0	1
IMD Quintile Unknown	79424	0.015	0.121	0	1
Sunday admission	79424	0.119	0.323	0	1
Monday admission	79424	0.160	0.367	0	1
Tuesday admission	79424	0.153	0.360	0	1
Wednesday admission	79424	0.149	0.356	0	1
Thursday admission	79424	0.149	0.356	0	1
Friday admission	79424	0.148	0.355	0	1
Saturday admission	79424	0.122	0.328	0	1
Christmas 2006 admission	79424	0.005	0.069	0	1
Easter 2006 admission	79424	0.005	0.070	0	1
No. of acute beds	79422	757.866	390.862	68	1932
Bed occupancy rate	79422	0.844	0.056	0.6739131	0.9944444
Teaching hospital	79422	0.172	0.378	0	1
Specialist hospital	79422	0.003	0.050	0	1
London hospital	79422	0.128	0.334	0	1
FCEs s.t. PbR rate	79422	0.567	0.279	0.3141375	1

Table A24 Descriptive statistics for the variables employed in the stroke regression models for 2007/08

Variable	Obs	Mean	Std. Dev.	Min	Max
Survived	79601	0.772	0.420	0	1
Re-admitted	61415	0.098	0.297	0	1
Age 1-60 years	79509	0.144	0.351	0	1
Age 61-70 years	79509	0.162	0.368	0	1
Age 71-80 years	79509	0.290	0.454	0	1
Age 81-85 years	79509	0.186	0.389	0	1
Age over 86 years	79509	0.219	0.414	0	1
Age	79509	74.85	13.73	1	106
Male	79601	0.477	0.499	0	1
Charlson index=0	79601	0.563	0.496	0	1
Charlson index=1	79601	0.271	0.445	0	1
Charlson index=2	79601	0.166	0.372	0	1
Pneumonia	79601	0.099	0.298	0	1
Intracerebral haemorrhage	79601	0.142	0.349	0	1
Cerebral infarction	79601	0.618	0.486	0	1
Unspecified stroke	79601	0.240	0.427	0	1
Emergency	79601	0.948	0.222	0	1
Patient dies	79601	0.228	0.420	0	1
Transfer in	78649	0.093	0.290	0	1
Transfer out	78649	0.197	0.398	0	1
Hemi/paraplegia	79601	0.069	0.253	0	1
No. of diagnoses	79601	5.694	3.296	1	39
No. of procedures	79601	2.094	1.731	0	27
IMD Quintile 1	79601	0.228	0.420	0	1
IMD Quintile 2	79601	0.260	0.439	0	1
IMD Quintile 3	79601	0.225	0.417	0	1
IMD Quintile 4	79601	0.178	0.383	0	1
IMD Quintile 5 (least deprived)	79601	0.091	0.288	0	1
IMD Quintile Unknown	79601	0.017	0.130	0	1
Sunday admission	79601	0.121	0.326	0	1
Monday admission	79601	0.158	0.365	0	1
Tuesday admission	79601	0.150	0.357	0	1
Wednesday admission	79601	0.149	0.356	0	1
Thursday admission	79601	0.149	0.356	0	1
Friday admission	79601	0.150	0.357	0	1
Saturday admission	79601	0.122	0.328	0	1
Christmas 2007 admission	79601	0.005	0.071	0	1
Easter 2007 admission	79601	0.008	0.091	0	1
No. of acute beds	79601	748.881	387.557	65	1811
Bed occupancy rate	79601	0.847	0.063	0.6153846	1
Teaching hospital	79601	0.174	0.379	0	1
Specialist hospital	79601	0.002	0.045	0	1
London hospital	79601	0.124	0.329	0	1
FCEs s.t. PbR rate	79601	0.763	0.181	0.5598127	1

Table A25 Descriptive statistics for the variables employed in the hip replacement regression models for 2002/03

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	76,505	0.960	0.197	0	1
Readmission dummy	73,410	0.078	0.268	0	1
Age 1-63 years	76,443	0.195	0.396	0	1
Age 64-71 years	76,443	0.215	0.411	0	1
Age 72-77 years	76,443	0.195	0.396	0	1
Age 78 -83 years	76,443	0.202	0.402	0	1
Age over 84 years	76,443	0.192	0.394	0	1
Age	76,443	73.12	12.00	4	106
Male	76,505	0.328	0.469	0	1
Charlson index=0	76,505	0.769	0.422	0	1
Charlson index=1	76,505	0.164	0.371	0	1
Charlson index=2	76,505	0.067	0.249	0	1
Hip fracture dummy	76,505	0.312	0.463	0	1
Partial hip replacement	76,505	0.312	0.463	0	1
Revision dummy	76,505	0.124	0.329	0	1
Emergency	76,505	0.381	0.486	0	1
Patient dies	76,505	0.040	0.197	0	1
Transfer in	76,024	0.026	0.160	0	1
Transfer out	76,024	0.128	0.334	0	1
No. of diagnoses	76,505	3.229	2.457	1	28
No. of procedures	76,505	2.507	1.061	1	21
IMD Quintile 1	76,505	0.143	0.350	0	1
IMD Quintile 2	76,505	0.226	0.418	0	1
IMD Quintile 3	76,505	0.220	0.414	0	1
IMD Quintile 4	76,505	0.212	0.409	0	1
IMD Quintile 5 (least deprived)	76,505	0.187	0.390	0	1
IMD Unknown	76,505	0.013	0.113	0	1
Sunday admission	76,505	0.135	0.342	0	1
Monday admission	76,505	0.181	0.385	0	1
Tuesday admission	76,505	0.168	0.374	0	1
Wednesday admission	76,505	0.185	0.389	0	1
Thursday admission	76,505	0.161	0.368	0	1
Friday admission	76,505	0.109	0.311	0	1
Saturday admission	76,505	0.061	0.238	0	1
Christmas 2002 admission	76,505	0.003	0.053	0	1
Easter 2002 admission	76,505	0.003	0.054	0	1
No. of acute beds	75,768	712.860	395.117	127	2142
Bed occupancy rate	75,768	0.851	0.056	0.6858476	0.9953488
Teaching hospital	76,505	0.129	0.336	0	1
Specialist hospital	76,505	0.041	0.199	0	1
London hospital	76,505	0.109	0.312	0	1
FCEs s.t. PbR rate	76,505	0.000	0.000	0	0

Table A26 Descriptive statistics for the variables employed in the hip replacement regression models for 2003/04

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	81,172	0.962	0.191	0	1
Readmission dummy	78,081	0.077	0.267	0	1
Age 1-63 years	81,146	0.191	0.393	0	1
Age 64-71 years	81,146	0.223	0.416	0	1
Age 72-77 years	81,146	0.200	0.400	0	1
Age 78 -83 years	81,146	0.205	0.404	0	1
Age over 84 years	81,146	0.180	0.385	0	1
Age	81,146	73.02	11.85	6	106
Male	81,172	0.331	0.471	0	1
Charlson index=0	81,172	0.758	0.428	0	1
Charlson index=1	81,172	0.173	0.378	0	1
Charlson index=2	81,172	0.070	0.254	0	1
Hip fracture dummy	81,172	0.297	0.457	0	1
Partial hip replacement	81,172	0.295	0.456	0	1
Revision dummy	81,172	0.130	0.337	0	1
Emergency	81,172	0.368	0.482	0	1
Patient dies	81,172	0.038	0.191	0	1
Transfer in	80,686	0.025	0.156	0	1
Transfer out	80,686	0.130	0.337	0	1
No. of diagnoses	81,172	3.297	2.481	1	29
No. of procedures	81,172	2.514	1.068	1	19
IMD Quintile 1	81,172	0.140	0.347	0	1
IMD Quintile 2	81,172	0.218	0.413	0	1
IMD Quintile 3	81,172	0.224	0.417	0	1
IMD Quintile 4	81,172	0.216	0.411	0	1
IMD Quintile 5 (least deprived)	81,172	0.192	0.394	0	1
IMD Unknown	81,172	0.010	0.101	0	1
Sunday admission	81,172	0.134	0.341	0	1
Monday admission	81,172	0.181	0.385	0	1
Tuesday admission	81,172	0.177	0.382	0	1
Wednesday admission	81,172	0.184	0.387	0	1
Thursday admission	81,172	0.158	0.365	0	1
Friday admission	81,172	0.107	0.309	0	1
Saturday admission	81,172	0.060	0.237	0	1
Christmas 2003 admission	81,172	0.002	0.048	0	1
Easter 2003 admission	81,172	0.004	0.065	0	1
No. of acute beds	81,172	738.144	397.834	132	2119
Bed occupancy rate	81,172	0.853	0.056	0.7152318	0.9674267
Teaching hospital	81,172	0.132	0.338	0	1
Specialist hospital	81,172	0.040	0.197	0	1
London hospital	81,172	0.106	0.308	0	1
FCEs s.t. PbR rate	81,172	0.026	0.033	0.0009227	0.2041691

Table A27 Descriptive statistics for the variables employed in the hip replacement regression models for 2004/05

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	81173	0.961	0.193	0	1
Readmission dummy	78014	0.080	0.272	0	1
Age 1-63 years	81149	0.190	0.393	0	1
Age 64-71 years	81149	0.217	0.412	0	1
Age 72-77 years	81149	0.200	0.400	0	1
Age 78 -83 years	81149	0.200	0.400	0	1
Age over 84 years	81149	0.193	0.395	0	1
Age	81149	73.20	11.91	9	106
Male	81173	0.333	0.471	0	1
Charlson index=0	81173	0.731	0.444	0	1
Charlson index=1	81173	0.192	0.394	0	1
Charlson index=2	81173	0.078	0.268	0	1
Hip fracture dummy	81173	0.300	0.458	0	1
Partial hip replacement	81173	0.295	0.456	0	1
Revision dummy	81173	0.138	0.345	0	1
Emergency	81173	0.377	0.485	0	1
Patient dies	81173	0.039	0.193	0	1
Transfer in	80876	0.029	0.167	0	1
Transfer out	80876	0.127	0.333	0	1
No. of diagnoses	81173	3.576	2.578	1	31
No. of procedures	81173	2.535	1.092	1	20
IMD Quintile 1	81173	0.136	0.343	0	1
IMD Quintile 2	81173	0.220	0.414	0	1
IMD Quintile 3	81173	0.220	0.414	0	1
IMD Quintile 4	81173	0.219	0.413	0	1
IMD Quintile 5 (least deprived)	81173	0.193	0.395	0	1
IMD Unknown	81173	0.013	0.113	0	1
Sunday admission	81173	0.131	0.337	0	1
Monday admission	81173	0.182	0.386	0	1
Tuesday admission	81173	0.179	0.384	0	1
Wednesday admission	81173	0.183	0.387	0	1
Thursday admission	81173	0.160	0.367	0	1
Friday admission	81173	0.102	0.303	0	1
Saturday admission	81173	0.062	0.241	0	1
Christmas 2004 admission	81173	0.002	0.047	0	1
Easter 2004 admission	81173	0.005	0.069	0	1
No. of acute beds	81173	731.588	384.745	125	2072
Bed occupancy rate	81173	0.846	0.056	0.726	0.978
Teaching hospital	81173	0.129	0.336	0	1
Specialist hospital	81173	0.038	0.191	0	1
London hospital	81173	0.104	0.305	0	1
FCEs s.t. PbR rate	81173	0.209	0.325	0.019	1

Table A28 Descriptive statistics for the variables employed in the hip replacement regression models for 2005/06

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	83005	0.962	0.191	0	1
Readmission dummy	79858	0.083	0.276	0	1
Age 1-63 years	82989	0.194	0.396	0	1
Age 64-71 years	82989	0.212	0.409	0	1
Age 72-77 years	82989	0.198	0.398	0	1
Age 78 -83 years	82989	0.194	0.395	0	1
Age over 84 years	82989	0.203	0.402	0	1
Age	82989	73.23	12.02	1	105
Male	83005	0.333	0.471	0	1
Charlson index=0	83005	0.710	0.454	0	1
Charlson index=1	83005	0.205	0.404	0	1
Charlson index=2	83005	0.084	0.278	0	1
Hip fracture dummy	83005	0.300	0.458	0	1
Partial hip replacement	83005	0.292	0.455	0	1
Revision dummy	83005	0.142	0.349	0	1
Emergency	83005	0.378	0.485	0	1
Patient dies	83005	0.038	0.191	0	1
Transfer in	82761	0.028	0.166	0	1
Transfer out	82761	0.124	0.329	0	1
No. of diagnoses	83005	3.768	2.702	1	30
No. of procedures	83005	2.523	1.054	1	18
IMD Quintile 1	83005	0.135	0.342	0	1
IMD Quintile 2	83005	0.217	0.412	0	1
IMD Quintile 3	83005	0.221	0.415	0	1
IMD Quintile 4	83005	0.218	0.413	0	1
IMD Quintile 5 (least deprived)	83005	0.194	0.396	0	1
IMD Unknown	83005	0.015	0.120	0	1
Sunday admission	83005	0.126	0.331	0	1
Monday admission	83005	0.181	0.385	0	1
Tuesday admission	83005	0.179	0.383	0	1
Wednesday admission	83005	0.183	0.386	0	1
Thursday admission	83005	0.166	0.372	0	1
Friday admission	83005	0.105	0.307	0	1
Saturday admission	83005	0.061	0.239	0	1
Christmas 2005 admission	83005	0.002	0.048	0	1
Easter 2005 admission	83005	0.000	0.000	0	0
No. of acute beds	83005	720.858	380.112	79	2006
Bed occupancy rate	83005	0.839	0.065	0.633	0.992
Teaching hospital	83005	0.125	0.331	0	1
Specialist hospital	83005	0.037	0.189	0	1
London hospital	83005	0.104	0.305	0	1
FCEs s.t. PbR rate	83005	0.310	0.317	0.0733	1

Table A29 Descriptive statistics for the variables employed in the hip replacement regression models for 2006/07

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	85,949	0.964	0.186	0	1
Readmission dummy	82,849	0.085	0.279	0	1
Age 1-63 years	85,921	0.197	0.398	0	1
Age 64-71 years	85,921	0.210	0.408	0	1
Age 72-77 years	85,921	0.203	0.402	0	1
Age 78 -83 years	85,921	0.187	0.390	0	1
Age over 84 years	85,921	0.202	0.402	0	1
Age	85,921	73.15	12.01	4	106
Male	85,949	0.337	0.473	0	1
Charlson index=0	85,949	0.693	0.461	0	1
Charlson index=1	85,949	0.214	0.410	0	1
Charlson index=2	85,949	0.093	0.290	0	1
Hip fracture dummy	85,949	0.295	0.456	0	1
Partial hip replacement	85,949	0.285	0.452	0	1
Revision dummy	85,949	0.108	0.310	0	1
Emergency	85,949	0.372	0.483	0	1
Patient dies	85,949	0.036	0.186	0	1
Transfer in	85,582	0.027	0.163	0	1
Transfer out	85,582	0.116	0.320	0	1
No. of diagnoses	85,949	3.976	2.784	1	32
No. of procedures	85,949	2.563	1.164	1	26
IMD Quintile 1	85,949	0.135	0.342	0	1
IMD Quintile 2	85,949	0.216	0.412	0	1
IMD Quintile 3	85,949	0.216	0.412	0	1
IMD Quintile 4	85,949	0.219	0.414	0	1
IMD Quintile 5 (least deprived)	85,949	0.200	0.400	0	1
IMD Unknown	85,949	0.014	0.118	0	1
Sunday admission	85,949	0.110	0.313	0	1
Monday admission	85,949	0.178	0.382	0	1
Tuesday admission	85,949	0.180	0.384	0	1
Wednesday admission	85,949	0.185	0.388	0	1
Thursday admission	85,949	0.172	0.378	0	1
Friday admission	85,949	0.113	0.316	0	1
Saturday admission	85,949	0.062	0.241	0	1
Christmas 2006 admission	85,949	0.003	0.057	0	1
Easter 2006 admission	85,949	0.004	0.060	0	1
No. of acute beds	85,949	711.367	386.965	68	1932
Bed occupancy rate	85,949	0.837	0.062	0.643	0.994
Teaching hospital	85,949	0.127	0.334	0	1
Specialist hospital	85,949	0.039	0.194	0	1
London hospital	85,949	0.103	0.305	0	1
FCEs s.t. PbR rate	85,949	0.578	0.278	0.314	1

Table A30 Descriptive statistics for the variables employed in the hip replacement regression models for 2007/08

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	91,751	0.967	0.178	0	1
Readmission dummy	88,741	0.080	0.271	0	1
Age 1-63 years	91,666	0.203	0.402	0	1
Age 64-71 years	91,666	0.210	0.407	0	1
Age 72-77 years	91,666	0.201	0.401	0	1
Age 78 -83 years	91,666	0.186	0.389	0	1
Age over 84 years	91,666	0.201	0.401	0	1
Age	91,666	72.97	12.161	6	106
Male	91,751	0.340	0.474	0	1
Charlson index=0	91,751	0.678	0.467	0	1
Charlson index=1	91,751	0.220	0.415	0	1
Charlson index=2	91,751	0.102	0.302	0	1
Hip fracture dummy	91,751	0.289	0.453	0	1
Partial hip replacement	91,751	0.275	0.446	0	1
Revision dummy	91,751	0.091	0.287	0	1
Emergency	91,751	0.364	0.481	0	1
Patient dies	91,751	0.033	0.178	0	1
Transfer in	91,403	0.032	0.176	0	1
Transfer out	91,403	0.109	0.312	0	1
No. of diagnoses	91,751	4.094	2.873	1	28
No. of procedures	91,751	2.593	1.292	1	33
IMD Quintile 1	91,751	0.162	0.368	0	1
IMD Quintile 2	91,751	0.243	0.429	0	1
IMD Quintile 3	91,751	0.250	0.433	0	1
IMD Quintile 4	91,751	0.211	0.408	0	1
IMD Quintile 5 (least deprived)	91,751	0.117	0.322	0	1
IMD Unknown	91,751	0.017	0.128	0	1
Sunday admission	91,751	0.097	0.296	0	1
Monday admission	91,751	0.174	0.380	0	1
Tuesday admission	91,751	0.175	0.380	0	1
Wednesday admission	91,751	0.175	0.380	0	1
Thursday admission	91,751	0.171	0.376	0	1
Friday admission	91,751	0.129	0.336	0	1
Saturday admission	91,751	0.079	0.269	0	1
Christmas 2007 admission	91,751	0.003	0.051	0	1
Easter 2007 admission	91,751	0.005	0.067	0	1
No. of acute beds	91,751	701.853	386.335	65	1811
Bed occupancy rate	91,751	0.837	0.071	0.633	0.984
Teaching hospital	91,751	0.129	0.335	0	1
Specialist hospital	91,751	0.040	0.197	0	1
London hospital	91,751	0.097	0.295	0	1
FCEs s.t. PbR rate	91,751	0.772	0.180	0.560	1

Table A31 Descriptive statistics for the variables employed in the hernia repair regression models for 2002/03

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	69,093	0.998	0.043	0	1
Readmission dummy	68,964	0.017	0.131	0	1
Age 1-42 years	69,084	0.212	0.409	0	1
Age 43-56 years	69,084	0.217	0.412	0	1
Age 57-65 years	69,084	0.190	0.392	0	1
Age 66-74 years	69,084	0.195	0.396	0	1
Age over 75 years	69,084	0.186	0.389	0	1
Age	69,084	57.45	18.25	1	104
Male	69,093	0.930	0.255	0	1
Charlson index=0	69,093	0.913	0.281	0	1
Charlson index=1	69,093	0.069	0.254	0	1
Charlson index=2	69,093	0.017	0.131	0	1
Inguinal hernia: unilateral diagnosis	69,093	0.903	0.296	0	1
Inguinal hernia: bilateral diagnosis	69,093	0.065	0.246	0	1
Inguinal hernia: other diagnosis	69,093	0.032	0.176	0	1
Comorbidity: hypertension dummy	69,093	0.083	0.275	0	1
Comorbidity: connective tissue disorder	69,093	0.016	0.125	0	1
Laparoscopic repair	69,093	0.059	0.235	0	1
Presence of implant	69,093	0.807	0.395	0	1
Emergency	69,093	0.051	0.220	0	1
Patient dies	69,093	0.002	0.043	0	1
Transfer in	68,959	0.003	0.054	0	1
Transfer out	68,959	0.005	0.068	0	1
No. of diagnoses	69,093	1.591	1.167	1	19
No. of procedures	69,093	2.200	0.617	1	12
IMD Quintile 1	69,093	0.160	0.367	0	1
IMD Quintile 2	69,093	0.221	0.415	0	1
IMD Quintile 3	69,093	0.212	0.409	0	1
IMD Quintile 4	69,093	0.210	0.407	0	1
IMD Quintile 5 (least deprived)	69,093	0.193	0.394	0	1
IMD Unknown	69,093	0.005	0.067	0	1
Sunday admission	69,093	0.043	0.203	0	1
Monday admission	69,093	0.192	0.394	0	1
Tuesday admission	69,093	0.183	0.387	0	1
Wednesday admission	69,093	0.190	0.393	0	1
Thursday admission	69,093	0.193	0.395	0	1
Friday admission	69,093	0.153	0.360	0	1
Saturday admission	69,093	0.045	0.207	0	1
Christmas 2002 admission	69,093	0.000	0.016	0	1
Easter 2002 admission	69,093	0.001	0.032	0	1
No. of acute beds	68,359	742.367	391.188	74	2142
Bed occupancy rate	68,359	0.858	0.054	0.686	0.995
Teaching hospital	69,093	0.153	0.360	0	1
Specialist hospital	69,093	0.001	0.028	0	1
London hospital	69,093	0.133	0.339	0	1
FCEs s.t. PbR rate	69,093	0.000	0.000	0	0

Table A32 Descriptive statistics for the variables employed in the hernia repair regression models for 2003/04

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	70,894	0.998	0.040	0	1
Readmission dummy	70,779	0.018	0.134	0	1
Age 1-42 years	70,879	0.205	0.404	0	1
Age 43-56 years	70,879	0.210	0.407	0	1
Age 57-65 years	70,879	0.192	0.394	0	1
Age 66-74 years	70,879	0.202	0.401	0	1
Age over 75 years	70,879	0.191	0.393	0	1
Age	70,879	57.95	18.06	1	103
Male	70,894	0.929	0.256	0	1
Charlson index=0	70,894	0.908	0.290	0	1
Charlson index=1	70,894	0.075	0.263	0	1
Charlson index=2	70,894	0.018	0.132	0	1
Inguinal hernia: unilateral diagnosis	70,894	0.899	0.301	0	1
Inguinal hernia: bilateral diagnosis	70,894	0.068	0.252	0	1
Inguinal hernia: other diagnosis	70,894	0.032	0.177	0	1
Comorbidity: hypertension dummy	70,894	0.096	0.294	0	1
Comorbidity: connective tissue disorder	70,894	0.017	0.130	0	1
Laparoscopic repair	70,894	0.068	0.252	0	1
Presence of implant	70,894	0.818	0.386	0	1
Emergency	70,894	0.051	0.220	0	1
Patient dies	70,894	0.002	0.040	0	1
Transfer in	70,731	0.003	0.050	0	1
Transfer out	70,731	0.005	0.068	0	1
No. of diagnoses	70,894	1.643	1.208	1	21
No. of procedures	70,894	2.203	0.630	1	12
IMD Quintile 1	70,894	0.158	0.365	0	1
IMD Quintile 2	70,894	0.222	0.416	0	1
IMD Quintile 3	70,894	0.209	0.406	0	1
IMD Quintile 4	70,894	0.211	0.408	0	1
IMD Quintile 5 (least deprived)	70,894	0.196	0.397	0	1
IMD Unknown	70,894	0.004	0.063	0	1
Sunday admission	70,894	0.040	0.195	0	1
Monday admission	70,894	0.201	0.401	0	1
Tuesday admission	70,894	0.193	0.395	0	1
Wednesday admission	70,894	0.194	0.396	0	1
Thursday admission	70,894	0.192	0.394	0	1
Friday admission	70,894	0.149	0.356	0	1
Saturday admission	70,894	0.031	0.175	0	1
Christmas 2003 admission	70,894	0.000	0.015	0	1
Easter 2003 admission	70,894	0.001	0.035	0	1
No. of acute beds	70,894	761.559	382.327	75	2119
Bed occupancy rate	70,894	0.861	0.052	0.660	0.967
Teaching hospital	70,894	0.156	0.363	0	1
Specialist hospital	70,894	0.001	0.028	0	1
London hospital	70,894	0.130	0.336	0	1
FCEs s.t. PbR rate	70,894	0.019	0.006	0.0009	0.043

Table A33 Descriptive statistics for the variables employed in the hernia repair regression models for 2004/05

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	68,723	0.998	0.040	0	1
Readmission dummy	68,612	0.020	0.139	0	1
Age 1-42 years	68,715	0.204	0.403	0	1
Age 43-56 years	68,715	0.203	0.402	0	1
Age 57-65 years	68,715	0.202	0.402	0	1
Age 66-74 years	68,715	0.198	0.399	0	1
Age over 75 years	68,715	0.192	0.394	0	1
Age	68,715	58.01	18.05	1	103
Male	68,723	0.927	0.261	0	1
Charlson index=0	68,723	0.897	0.304	0	1
Charlson index=1	68,723	0.082	0.275	0	1
Charlson index=2	68,723	0.020	0.141	0	1
Inguinal hernia: unilateral diagnosis	68,723	0.895	0.307	0	1
Inguinal hernia: bilateral diagnosis	68,723	0.071	0.257	0	1
Inguinal hernia: other diagnosis	68,723	0.034	0.181	0	1
Comorbidity: hypertension dummy	68,723	0.113	0.316	0	1
Comorbidity: connective tissue disorder	68,723	0.020	0.138	0	1
Laparoscopic repair	68,723	0.082	0.274	0	1
Presence of implant	68,723	0.833	0.373	0	1
Emergency	68,723	0.055	0.227	0	1
Patient dies	68,723	0.002	0.040	0	1
Transfer in	68,681	0.003	0.053	0	1
Transfer out	68,681	0.004	0.062	0	1
No. of diagnoses	68,723	1.714	1.280	1	22
No. of procedures	68,723	2.220	0.631	1	12
IMD Quintile 1	68,723	0.154	0.361	0	1
IMD Quintile 2	68,723	0.216	0.412	0	1
IMD Quintile 3	68,723	0.212	0.409	0	1
IMD Quintile 4	68,723	0.213	0.409	0	1
IMD Quintile 5 (least deprived)	68,723	0.199	0.399	0	1
IMD Unknown	68,723	0.005	0.071	0	1
Sunday admission	68,723	0.033	0.178	0	1
Monday admission	68,723	0.194	0.396	0	1
Tuesday admission	68,723	0.195	0.396	0	1
Wednesday admission	68,723	0.201	0.401	0	1
Thursday admission	68,723	0.202	0.401	0	1
Friday admission	68,723	0.154	0.361	0	1
Saturday admission	68,723	0.021	0.144	0	1
Christmas 2004 admission	68,723	0.000	0.013	0	1
Easter 2004 admission	68,723	0.002	0.044	0	1
No. of acute beds	68,723	757.090	374.629	74	2072
Bed occupancy rate	68,723	0.854	0.054	0.660	0.978
Teaching hospital	68,723	0.155	0.361	0	1
Specialist hospital	68,723	0.001	0.030	0	1
London hospital	68,723	0.125	0.331	0	1
FCEs s.t. PbR rate	68,723	0.204	0.334	0.019	1

Table 34 Descriptive statistics for the variables employed in the hernia repair regression models for 2005/06

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	68,718	0.998181	0.0426116	0	1
Readmission dummy	68,593	0.0203519	0.1412021	0	1
Age 1-42 years	68,714	0.2028117	0.4020963	0	1
Age 43-56 years	68,714	0.1992316	0.3994254	0	1
Age 57-65 years	68,714	0.2046162	0.4034238	0	1
Age 66-74 years	68,714	0.1967867	0.3975726	0	1
Age over 75 years	68,714	0.1965538	0.3973949	0	1
Age	68,714	58.13383	18.1112	1	101
Male	68,718	0.9273407	0.2595783	0	1
Charlson index=0	68,718	0.8819814	0.3226325	0	1
Charlson index=1	68,718	0.0946622	0.29275	0	1
Charlson index=2	68,718	0.0233563	0.1510336	0	1
Inguinal hernia: unilateral diagnosis	68,718	0.8879042	0.3154866	0	1
Inguinal hernia: bilateral diagnosis	68,718	0.0775634	0.2674852	0	1
Inguinal hernia: other diagnosis	68,718	0.0345324	0.1825936	0	1
Comorbidity: hypertension dummy	68,718	0.1346663	0.3413693	0	1
Comorbidity: connective tissue disorder	68,718	0.0258593	0.1587166	0	1
Laparoscopic repair	68,718	0.1111063	0.314266	0	1
Presence of implant	68,718	0.8344102	0.3717147	0	1
Emergency	68,718	0.0513112	0.2206332	0	1
Patient dies	68,718	0.001819	0.0426116	0	1
Transfer in	68,669	0.0033348	0.0576521	0	1
Transfer out	68,669	0.0037863	0.0614166	0	1
No. of diagnoses	68,718	1.8128	1.372986	1	25
No. of procedures	68,718	2.250822	0.6219453	1	10
IMD Quintile 1	68,718	0.153948	0.3609015	0	1
IMD Quintile 2	68,718	0.2171338	0.4122974	0	1
IMD Quintile 3	68,718	0.2102651	0.4074999	0	1
IMD Quintile 4	68,718	0.2117931	0.408582	0	1
IMD Quintile 5 (least deprived)	68,718	0.2016648	0.4012461	0	1
IMD Unknown	68,718	0.0051951	0.0718904	0	1
Sunday admission	68,718	0.0299776	0.1705267	0	1
Monday admission	68,718	0.1887715	0.3913298	0	1
Tuesday admission	68,718	0.2006461	0.4004867	0	1
Wednesday admission	68,718	0.1948252	0.396069	0	1
Thursday admission	68,718	0.2017375	0.4013002	0	1
Friday admission	68,718	0.1679036	0.3737834	0	1
Saturday admission	68,718	0.0161384	0.1260087	0	1
Christmas 2005 admission	68,718	0.0002037	0.0142721	0	1
Easter 2005 admission	68,718	0	0	0	0
No. of acute beds	68,718	743.8443	371.829	76	2006
Bed occupancy rate	68,718	0.8489695	0.0593004	0.633	0.992
Teaching hospital	68,718	0.1520562	0.359078	0	1
Specialist hospital	68,718	0.0014407	0.0379291	0	1
London hospital	68,718	0.1289036	0.3350957	0	1
FCEs s.t. PbR rate	68,718	0.3016875	0.321952	0.073	1

Table 35 Descriptive statistics for the variables employed in the hernia repair regression models for 2006/07

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	67,252	0.998632	0.0369613	0	1
Readmission dummy	67,160	0.0199375	0.1397864	0	1
Age 1-42 years	67,236	0.2047861	0.4035483	0	1
Age 43-56 years	67,236	0.1968588	0.3976277	0	1
Age 57-65 years	67,236	0.205039	0.4037331	0	1
Age 66-74 years	67,236	0.1968291	0.397605	0	1
Age over 75 years	67,236	0.196487	0.3973439	0	1
Age	67,236	58.127	18.137	1	101
Male	67,252	0.9276304	0.2591008	0	1
Charlson index=0	67,252	0.0505561	0.2190911	0	1
Charlson index=1	67,252	0.1032386	0.3042725	0	1
Charlson index=2	67,252	0.0264379	0.1604347	0	1
Inguinal hernia: unilateral diagnosis	67,252	0.8835871	0.3207218	0	1
Inguinal hernia: bilateral diagnosis	67,252	0.0830905	0.276021	0	1
Inguinal hernia: other diagnosis	67,252	0.0333224	0.1794785	0	1
Comorbidity: hypertension dummy	67,252	0.1548207	0.3617363	0	1
Comorbidity: connective tissue disorder	67,252	0.0277464	0.1642465	0	1
Laparoscopic repair	67,252	0.1450812	0.3521853	0	1
Presence of implant	67,252	0.8376405	0.368783	0	1
Emergency	67,252	0.0505561	0.2190911	0	1
Patient dies	67,252	0.001368	0.0369613	0	1
Transfer in	67,225	0.0024693	0.0496312	0	1
Transfer out	67,225	0.0031982	0.0564627	0	1
No. of diagnoses	67,252	1.897431	1.441294	1	22
No. of procedures	67,252	2.300928	0.6695654	1	19
IMD Quintile 1	67,252	0.1565307	0.3633604	0	1
IMD Quintile 2	67,252	0.2179415	0.4128505	0	1
IMD Quintile 3	67,252	0.2084548	0.4062066	0	1
IMD Quintile 4	67,252	0.2093618	0.4068561	0	1
IMD Quintile 5 (least deprived)	67,252	0.2022393	0.4016727	0	1
IMD Unknown	67,252	0.005472	0.0737706	0	1
Sunday admission	67,252	0.0217391	0.1458316	0	1
Monday admission	67,252	0.1920984	0.3939529	0	1
Tuesday admission	67,252	0.1976001	0.3981917	0	1
Wednesday admission	67,252	0.1945667	0.3958697	0	1
Thursday admission	67,252	0.2081574	0.405993	0	1
Friday admission	67,252	0.1734521	0.3786405	0	1
Saturday admission	67,252	0.0123862	0.1106029	0	1
Christmas 2006 admission	67,252	0.0002677	0.0163579	0	1
Easter 2006 admission	67,252	0.0007583	0.0275278	0	1
No. of acute beds	67,252	734.233	375.6795	68	1932
Bed occupancy rate	67,252	0.8449691	0.056466	0.684	0.994
Teaching hospital	67,252	0.1523672	0.3593791	0	1
Specialist hospital	67,252	0.001368	0.0369613	0	1
London hospital	67,252	0.1276096	0.3336571	0	1
FCEs s.t. PbR rate	67,252	0.5745055	0.2823778	0.314	1

Table 36 Descriptive statistics for the variables employed in the hernia repair regression models for 2007/08

Variable	Obs	Mean	Std. Dev.	Min	Max
Survival dummy	70,279	0.9984064	0.039889	0	1
Readmission dummy	70,167	0.0197814	0.1392492	0	1
Age 1-42 years	70,271	0.2028148	0.4020986	0	1
Age 43-56 years	70,271	0.1945184	0.3958323	0	1
Age 57-65 years	70,271	0.2052056	0.4038546	0	1
Age 66-74 years	70,271	0.1954291	0.3965335	0	1
Age over 75 years	70,271	0.2020321	0.4015189	0	1
Age	70,271	58.25	18.26	1	104
Male	70,279	0.9243586	0.2644253	0	1
Charlson index=0	70,279	0.863985	0.342807	0	1
Charlson index=1	70,279	0.1069736	0.3090819	0	1
Charlson index=2	70,279	0.0290414	0.1679238	0	1
Inguinal hernia: unilateral diagnosis	70,279	0.8839198	0.3203233	0	1
Inguinal hernia: bilateral diagnosis	70,279	0.0849471	0.278805	0	1
Inguinal hernia: other diagnosis	70,279	0.0311331	0.1736785	0	1
Comorbidity: hypertension dummy	70,279	0.1647718	0.3709771	0	1
Comorbidity: connective tissue disorder	70,279	0.028458	0.1662785	0	1
Laparoscopic repair	70,279	0.1629078	0.3692842	0	1
Presence of implant	70,279	0.8437371	0.363107	0	1
Emergency	70,279	0.0480229	0.2138161	0	1
Patient dies	70,279	0.0015936	0.039889	0	1
Transfer in	70,246	0.0033881	0.0581091	0	1
Transfer out	70,246	0.0032884	0.057251	0	1
No. of diagnoses	70,279	1.946371	1.486274	1	19
No. of procedures	70,279	2.326954	0.7037407	1	13
IMD Quintile 1	70,279	0.1854608	0.3886737	0	1
IMD Quintile 2	70,279	0.2396022	0.4268437	0	1
IMD Quintile 3	70,279	0.2393887	0.4267134	0	1
IMD Quintile 4	70,279	0.2067332	0.4049653	0	1
IMD Quintile 5 (least deprived)	70,279	0.1203631	0.325388	0	1
IMD Unknown	70,279	0.008452	0.0915462	0	1
Sunday admission	70,279	0.0186827	0.1354027	0	1
Monday admission	70,279	0.1837818	0.3873089	0	1
Tuesday admission	70,279	0.1937136	0.3952099	0	1
Wednesday admission	70,279	0.1921057	0.3939586	0	1
Thursday admission	70,279	0.2011981	0.4008986	0	1
Friday admission	70,279	0.1817043	0.3856034	0	1
Saturday admission	70,279	0.0288137	0.1672839	0	1
Christmas 2007 admission	70,279	0.0002561	0.0160019	0	1
Easter 2007 admission	70,279	0.0010672	0.0326504	0	1
No. of acute beds	70,279	721.2362	374.3481	65	1811
Bed occupancy rate	70,279	0.8466107	0.0642208	0.633	1
Teaching hospital	70,279	0.1564052	0.3632416	0	1
Specialist hospital	70,279	0.0027747	0.0526022	0	1
London hospital	70,279	0.1269938	0.3329684	0	1
FCEs s.t. PbR rate	70,279	0.7625996	0.1808453	0.560	1